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# The Engineer.

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VOL. CXXXVIII.—No. 3580] LONDON: FRIDAY EVENING, AUGUST 8, 1924 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

## The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

The Leafield Wireless Station.

The British Empire Exhibition (Sixteenth Notice).

The Gauging of Finish-Ground Worms by Cylinders.

100 Years of British Railways—No. VI.

British Wire-Drawing and Wire-Working Machinery—No. IV.

100 Years of Electrical Engineering.

Proposed Combination of Steel Producers.

Large Plate-bending Rolls.

### PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for the SUPPLY of :—
TWO SELF-PROPELLING SUCTION DREDGERS with Radial Heads and Pumps, having 20in. diameter suction and delivery; also FLOATING DISCHARGE PIPES, TERMINAL PONTOONS, ANCHOR LIFTING PONTOONS, and FLOATING HIGH-PRESSURE HYDRAULIC PUMPING PLANTS.
Tender forms will be obtainable on the 11th August, 1924, at the above address. 6556

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1. REQUIRES :
GIRDER BRIDGES, Four 83ft. span.
Tenders due on the 22nd August, 1924.
Tender forms obtainable from above. 6503

Assistant Engineer Required by the GOVERNMENT of PALESTINE, for the PUBLIC WORKS DEPARTMENT, for three years, with prospect of permanency. Salary £E550-25-£E750 plus £E50 expatriation allowance. In addition a temporary cost of living allowance is at present payable, amounting to 5 per cent. on the minimum of the salary scale plus £E27, but this allowance may be substantially reduced or abolished at an early date. Free passages and, if married, for wife and children also, not exceeding four persons beside the candidate appointed. The duties of the office comprise the technical preparation and examination of projects for water supplies, drainage and irrigation schemes, new roads and steel and concrete bridges, and generally assisting the Director of Public Works. Candidates, aged 30 to 40, should be Associate Members of the Institution of Civil Engineers and have spent some time in the office of a Municipal or other Civil Engineer, where they have had the opportunity of gaining both indoor and outdoor experience in carrying out works of the above-mentioned descriptions, including estimating and designing.—Apply at once, by letter, stating age, whether married or single, and giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W., quoting at top of application reference M/12,939. 6571

Assistant Locomotive SUPERINTENDENT REQUIRED for the NIGERIAN GOVERNMENT RAILWAY, for two tours of from 12 to 18 months' service, with prospect of permanency. Salary £480 a year for the first three years, then £510, rising by annual increments of £30 to £720, and thence by annual increments of £40 to £920. Outfit allowance of £80 on first appointment. Free quarters and first-class passages and liberal leave on full salary. Candidates, age 25 to 35, should be of good education and preferably possess an approved Engineering Diploma. They should have served an apprenticeship in some well-known railway shops or with a recognised firm of locomotive builders, preferably the former. Must have had at least two years' experience in the running department of a large railway and should be qualified to act as an assistant works manager.—Apply at once by letter, stating age and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/Nigeria 13,001. 6585

Civil Engineers Required by the GOVERNMENT of CEYLON for appointment as Irrigation Engineers for three years in the first instance. Salary £500, rising to £900 a year by annual increments of £40 (£600 on attaining 30 years of age). Free passage provided. Candidates, 26 to 31 years of age, unmarried, must have had war service and passed the examinations to qualify for Associate Membership of the Institution of Civil Engineers or hold equivalent professional qualifications, and have had at least three years' practical experience on waterworks, drainage, or harbour and dock works.—Apply at once in writing, giving age and brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting at head of application M/12,653. 6558

District Engineer Required by the GOVERNMENT of BRITISH GUIANA, for two years' service, with prospect of permanency. Salary £600, rising by annual increments of £25 to £650 a year. Candidates, preferably single, must be A.M.I.C.E. and have had good engineering experience, preferably with a municipality or large public works contractor. Age 25 to 35.—Apply at once by letter, stating age, whether married or single, and giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting clearly at head of application M/12,958. 6594

Section Engineers Required for the CONSTRUCTION BRANCH of the FEDERATED MALAY STATES RAILWAYS, for four years' service, with possible extension. Salary 400 dollars a month, rising to 475 dollars a month by annual increments of 25 dollars a month plus a temporary and non-pensionable allowance of 10 per cent., which is liable to cancellation or revision, plus a commuted Field Allowance of 50 dollars a month. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is at present considerably less than that of 2s. 4d. in the United Kingdom. Free passage provided. On expiration of agreement a bonus of six months' salary may be allowed provided the work and conduct of the person engaged has been in every way satisfactory. Candidates, age 30 to 38 and unmarried, must be fully qualified railway engineers who have received good training and experience on recognised European, American or Colonial Railways. Members or Associate Members of the Institution of Civil Engineers preferred.—Apply at once by letter, stating age, whether married or single, and particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting at top of application M/12,797. 6584

### PUBLIC NOTICES

In the High Court of Justice 1924 A. No. 1499
Chancery Division
Mr. Justice Tomlin
IN THE MATTER OF LETTERS PATENT No. 10,498 of 1908 granted to Griffin S. Ackley in respect of Improvements in Winding Mechanism for Brake Chains and bearing date the 16th September 1908, and
IN THE MATTER OF THE PATENTS AND DESIGNS ACTS, 1907 and 1919.

Notice is Hereby Given that HELEN TERESA ACKLEY, of 459, Eastern Parkway, Brooklyn, New York, in the United States of America, Widow, WILLIAM THOMAS BRAGGER, of 2, Norfolk-street, Strand, London, W.C. 2, Engineers' Accountant, the Administrator in England for the said Helen Teresa Ackley of the Estate of Griffin S. Ackley and The British Ackley Brake and Supply Company Limited whose Registered Office is situate at 2 and 3, Norfolk-street, Strand, London, have applied that the TERM of the said LETTERS PATENT may be EXTENDED and NOTICE IS HEREBY GIVEN that on TUESDAY the 14th DAY of OCTOBER 1924 APPLICATION will be made to the Court that a day may be fixed before which the said Summons shall not be in the paper for hearing and any person may give notice of opposition to the said Summons and NOTICE IS HEREBY GIVEN that any person desirous of being heard in opposition to the said Summons must at least seven days before the said 14th October 1924 lodge notice thereof at the Chambers of the Vacation Judge at the Royal Courts of Justice Strand London and serve a copy thereof upon the undersigned the Applicants Solicitors. And NOTICE IS HEREBY FURTHER GIVEN that the address of the undersigned Solicitors is the address for service on the Applicants of any documents requiring service upon them in accordance with Order 53a Rule 3a of the Supreme Court.
MACDONALD and STACEY,
2, Norfolk-street,
6502 Strand, London, W.C.

Newcastle-upon-Tyne Education COMMITTEE.
RUTHERFORD TECHNICAL COLLEGE.
Principal: C. L. ECLAIR-HEATH, Wh.Sc., A.M.I.M.E.
APPLICATIONS are INVITED for APPOINTMENT of a LECTURER in MECHANICAL ENGINEERING. Applicants should have had a good technical and scientific education in a University or Technical College, have obtained a degree or its equivalent, and have had good drawing-office and works experience. It is desirable that candidates should have experience in the design and manufacture of internal combustion engines (including Diesel), and possess a good knowledge of hydraulics.
Salary according to Burnham Technical Scale, less 5 per cent.
Applications (on form to be obtained by sending stamped addressed foolscap envelope) to be returned to the undersigned not later than Tuesday, 19th August, 1924.
THOS. WALLING,
Director of Education.
Education Office, Northumberland-road. 6467

University College of Swansea.
APPLICATIONS are INVITED for the POST of LECTURER in CIVIL ENGINEERING. Salary £500 per annum. The appointment will date from October 1st, 1924.
Further particulars may be obtained from the undersigned, by whom applications must be received on or before August 23rd, 1924.
EDWIN DREW,
Registrar.
Singleton Park, Swansea. 6486

### PUBLIC NOTICES

The Royal Technical College, GLASGOW.
DEPARTMENTS OF ENGINEERING.
MECHANICS AND MECHANICAL ENGINEERING: Professor ALEXANDER L. MELLANBY, D.Sc., M.I. Mech. E.
Associate Professor WM. KERR, Ph.D., A.R.T.C.
ELECTRICAL ENGINEERING: Professor STANLEY PARKER SMITH, D.Sc., M.I.E.E., A.M. Inst. C.E.
CIVIL ENGINEERING: Professor GEORGE MONCUR, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.
MINING ENGINEERING: Professor DANIEL BURNS, M. Inst. M.E.
Complete Courses of Instruction are provided, qualifying for the Diploma of the College (three sessions) and for the Degree of B.Sc. in Engineering of Glasgow University (four sessions). Composition fee 25 guineas per annum.
Session 1924-25 begins on TUESDAY, SEPTEMBER 23rd.
Calendar, by post 2s., and prospectus, gratis, may be obtained on application to the DIRECTOR. 6566

University of Birmingham.
FACULTY OF SCIENCE.
ENGINEERING DEPARTMENTS.
I.—MECHANICAL ENGINEERING.
Chance Professor: F. W. BURSTALL, M.Sc., M.A. (Cantab.), M. Inst. C.E., M. Inst. M.E.
Lecturer: R. C. PORTER, M.Sc. (Vict.), A.M. Inst. C.E.
Demonstrator: S. J. ELLIS, B.Sc., A.M.I.C.E.
Lecturer on Machine Design: F. H. BODEN, B.Sc.
Assistant Lecturer on Machine Design: H. P. DEAN, B.Sc.
II.—CIVIL ENGINEERING.
Beale Professor: CYRIL BATHO, D.Sc., B.Eng.
Lecturers: R. C. PANTON, M.Sc.
H. W. COULTAS, M.Sc.
T. H. P. VEAL, B.Sc.
Lecturer on Town Planning: W. HAYWOOD.
III.—ELECTRICAL ENGINEERING.
Professor: WILLIAM CRAMP, D.Sc.
Lecturer: E. J. KIPPS, M.Sc., M. Inst. E.E.
Assistant Lecturers and Demonstrators: O. R. RANDALL, M.Sc.
G. M. HARVEY, M.Sc., B.Eng.
THE FULL COURSES EXTEND OVER FOUR YEARS, and students who enter after Matriculation and pass successfully the examinations at the end of each year will be ENTITLED to the DEGREE of BACHELOR OF SCIENCE in Engineering.
THE SESSION 1924-25 COMMENCES on OCTOBER 6th, 1924.
For detailed syllabus of the Faculty with full particulars of University Regulations, Lecture and Laboratory Courses, Fees, &c., apply to the REGISTRAR. 6452

Tenders are Invited by the MID KENT WATER COMPANY for the CONSTRUCTION at Barham, near Canterbury, of TWO UNLINED BORE-HOLES in the chalk. Particulars can be obtained from the undersigned. Tenders are to be delivered not later than Saturday August 23rd, 1924. The Company do not bind themselves to accept the lowest or any Tender.
F. L. BALL,
Engineer to the Company.
The Mid Kent Water Company, Snodland, Kent. 6565

### PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
Notice is Hereby Given that JOSEPH ARNOLD GROEBLI, of 605, West 156th-street, City, County and State of New York, United States of America, a citizen of the United States of America, SEEKS LEAVE to AMEND the SPECIFICATION for LETTERS PATENT No. 214,752 and entitled "Improvements in Head Sewing Machines." Particulars of the proposed amendment were set forth in the Illustrated Official Journal (Patents) issued on the 30th July, 1924.
Any person or persons may give notice of opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. TEMPLE FRANKS,
6554 Comptroller-General.

Broadstairs and St. Peters URBAN DISTRICT COUNCIL.
WATERWORKS.
CONTRACT NO. 1.—PUMPING MACHINERY.
The Council are prepared to receive TENDERS for the PROVISION and ERECTION at their Ramsgate Pumping Station of AIRLESS INJECTION COLD STARTING CRUDE OIL ENGINES, Mather and Platt TURBINE PUMPS, and other AUXILIARY PLANT, in accordance with the specification and drawings prepared by the Council's Consulting Engineers, Messrs. H. Rofe and Son, 208, Abbey House, Victoria-street, Westminster, S.W. 1.
The drawings may be seen and a copy of the specification and form of Tender obtained at the offices of the Consulting Engineers upon the payment of the sum of Five Guineas, which will be returned after the receipt of a bona fide Tender.
Tenders to be sent to the undersigned on or before Ten o'clock in the forenoon of Friday, the 15th August, endorsed "Tender for Pumping Machinery."
The Council do not bind themselves to accept the lowest or any Tender.
L. A. SKINNER,
Clerk to the Council.
Pierremont Hall, Broadstairs,
July 21st, 1924. 6519

Dorking Rural District Council.
CAPEL DRAINAGE.
TO CONTRACTORS.
The Dorking Rural District Council are prepared to receive TENDERS for the CONSTRUCTION of about 6200 YARDS of STONEWARE SEWERS of 7in., and 9in. diameter, together with MANHOLES, FLUSHING TANKS, VENTILATING SHAFTS, and for the CONSTRUCTION of a SCREEN TANK, SETTLEMENT TANK, PERCOLATING FILTER, and other appurtenant WORKS in accordance with plans and specification prepared by the Engineers, Messrs. John Taylor and Sons, 38, Victoria-street, Westminster, S.W. 1.
Copies of the specification, bill of quantities and form of Tender may be obtained and the drawings may be seen at the offices of the Engineers upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.
Sealed Tenders, endorsed "Capel Drainage," addressed to the undersigned at his office at Dorking, must be received before Noon on Friday, the 22nd day of August, 1924.
The Council do not bind themselves to accept the lowest or any Tender.
By Order,
(Signed) WILLIAM J. DOWN,
Clerk to the Council.
Rural District Council Offices,
72, High-street, Dorking, Surrey. 6557

East Indian Railway.
The Directors are prepared to receive up to 11 a.m. on Wednesday, the 20th August instant, TENDERS for the SUPPLY of :—
(1) AXLE-BOXES for CARRIAGES and WAGONS.
(2) COUPLINGS for VACUUM BRAKE HOSE PIPES.
(3) DUPLICATE PARTS and FITTINGS for CARRIAGES and WAGONS.
(4) INDIA-RUBBER VACUUM BRAKE FITTINGS.
(5) LAMINATED SPRINGS and BACK PLATES.
(6) METALS.
(7) SCREW COUPLINGS.
(8) STEEL AXLES for CARRIAGES and WAGONS.
(9) STEEL AXLES for LOCOMOTIVES (Crank and Straight).
(10) STEEL BOILER TUBES and STEAM PIPES.
(11) STEEL TYRES for CARRIAGES and WAGONS.
(12) STEEL TYRES for LOCOMOTIVES.
Copies of the specifications can be obtained at the Company's offices on payment of £1 1s. each. This fee will not be returned.
G. E. LILLIE,
Secretary.
73-76, King William-street, London, E.C. 4,
7th August, 1924. 6595

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## PUBLIC NOTICES

# Port of Bristol.

**TWO SELF-PROPELLED STEEL HOPPER BARGES.**

The Docks Committee invite TENDERS for the CONSTRUCTION, DELIVERY, and MAINTENANCE for twelve months after delivery of TWO SELF-PROPELLED STEEL HOPPER BARGES of 60 tons capacity.

On and after Monday, the 11th day of August, 1924, copies of the specification and contract drawings, &c., can be obtained from the undersigned on production of a receipt showing that a deposit of £5 has been paid to the Bristol Docks Committee, to whom all cheques must be sent and made payable. The deposit will be returned to bona fide tenderers after the receipt of the Tender with all the prescribed documents and drawings.

The Tender must be enclosed in a sealed envelope, endorsed "Tender for Two Self-propelled Hopper Barges," and addressed to the General Manager and Secretary of the Docks Committee, 19, Queen-square, Bristol, and must be delivered to him, accompanied by all the prescribed documents and drawings, before 10 a.m. on Monday, the 1st day of September, 1924.

The Docks Committee do not bind themselves to accept the lowest or any Tender.

THOMAS A. PEACE,
Chief Engineer.

Chief Engineer's Office,
Avonmouth Dock, Bristol.
8th August, 1924. 6578

# Southampton Corporation

**WATERWORKS.**

**TENDERS FOR PIPES AND SLUICE VALVES.**

The Corporation invite alternative TENDERS for the SUPPLY of about 2000 YARDS of 36in. PIPES, about 3250 YARDS of 24in. PIPES, and about 100 TONS of SPECIAL CASTINGS:—

(a) Ordinary S. and S.C.I. Pipes for Lead Joints.
(b) Double Spigot Pipes with Turned Beads for Victaulic Joint and Victaulic Joints complete.
(c) Steel Water Pipes with Victaulic Joints complete.

Specifications, conditions of contract, bill of quantities and form of Tender may be obtained at the Waterworks Offices, 21, Shirley-road, Southampton.

The Corporation also invite alternative TENDERS for the SUPPLY of various SLUICE VALVES tested to a pressure of 600ft. head:—

(a) Double Socket Valves.
(b) Double Spigot Valves with Turned Beads for Victaulic Joint.

Particulars may be obtained from the Waterworks Engineer.

Sealed Tenders, suitably endorsed, must be delivered at the Town Clerk's Office, Southampton, by 10 a.m. on the 4th September next.

No pledge is given to accept any Tender.

R. R. LINTHORNE,
Town Clerk.

2nd August, 1924. 6564

# State Electricity Commission

**OF VICTORIA.**

**MELBOURNE, VICTORIA, AUSTRALIA.**

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme:

Copies of Tender form and specification will be available upon application to:—

Agent-General for Victoria,
Melbourne-place,
Strand, London, W.C. 2.

SPECIFICATION NO. 24/68.—22,000-VOLT INSULATORS.

CHARGE.—£2 2s. for the first three copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with Tender.

The specification may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on the prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 20th October, 1924.

R. LIDDELOW,
Secretary.

6545

DREDGER.
BRITISH MANUFACTURE ONLY.

# The Lee Conservancy Board

invite TENDERS, DESIGNS, and SPECIFICATIONS for a STEAM LADDER BUCKET DREDGER, 80ft. long by 12ft. beam, depth middle line 4ft. 6in., draught not to exceed 8ft., to dredge to a depth of 12ft. and raise not less than 65 tons per hour, to load into barges 4ft. 6in. above water line, and to be forward cutting to cut its own flotation. The framing and gear to be easily lowered so as to pass under bridges 9ft. 9in. above water line. The hull to be of steel to Lloyd's specification, with accommodation for two men to sleep on board. State time of delivery afloat ready for work on the Lee Navigation at Bromley Lock, Bow, London, E.

The Board do not bind themselves to accept the lowest or any Tender, and all designs offered are to be at the expense of the persons tendering.

Tenders, Designs, and Specifications giving full particulars to be delivered in sealed envelopes, marked "Dredger," not later than September 25th, 1924, to

CHARLES N. TWEEN, M. Inst. C.E.,
Engineer and Manager to the Board.

Enfield Lock, Middlesex. 6572

# The South Indian Railway Company,

Limited, are prepared to receive TENDERS for the SUPPLY of:—

100 WAGONS OF SORTS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Wagons," must be left with the undersigned not later than Twelve Noon on Friday, the 10th October, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of the specification.

Copies of the drawings may be obtained at the offices of the Consulting Engineers to the Company, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1.
5th August, 1924. 6582

# Resident Engineer Required at

ONCE for Restoration of Bideford Long Bridge (reinforced concrete). Contract now proceeding and expected to finish about January next. Applications, stating salary required and enclosing testimonials, to reach the undersigned not later than 18th August, 1924.

H. M. BAZELEY,
Bridge Steward.

24, Bridgeland-street, Bideford. 6539

# Skegness Urban District

COUNCIL.

ENGINEER MECHANIC REQUIRED at the Sewage Pumping Station. Forms of application (to be returned not later than the first post on Tuesday next, August 12th) and particulars of duties obtainable from the undersigned.

Canvassing will disqualify.

R. H. JENKINS, M. Inst. M. and C.E., &c.,
Surveyor.

Council Offices, Skegness,
5/8/24. 6588

## SITUATIONS OPEN

WANTED, a First-class ENGINEER AGENT, to Take Charge of Railway Construction Work abroad; only men with good experience of heavy construction work will be considered. Good salary to suitable man.—Address, with full particulars, P9419, The Engineer Office. P9419 A

WANTED, ENGINEER SALESMAN, Preferably with Yorkshire and Lancashire connection. State age, experience.—Address, 6555, The Engineer Office. 6555 A

WANTED, Thoroughly Competent and Experienced GENERAL MANAGER for Forest Saw Mill and Timber Business in Tasmania. Preferably with knowledge of American methods of timber production. Age 30 to 45.

Also WANTED for same undertaking, LOGGING and RAILWAY ENGINEER with thorough experience of American high lead and overhead methods of log extraction, also railway location and construction. Age 30 to 45. Liberal salaries, free passages, medical examination.—Write full particulars to Box K. A. C., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 6510 A

WILLIAMS and WILLIAMS, Ltd., Steel Window Manufacturers, Reliance Works, Chester.

WANTED, WORKS MANAGER, with Experience of quantity production, to TAKE FULL CHARGE of WORKS under MANAGING DIRECTOR, approximately 450 employees.

Letters (which will be treated in confidence) should, in the first instance, state age, salary, and experience, and enclose photograph. 6597 A

EMPLOYERS REQUIRING Reliable EX-NAVAL MEN for Charge of Machinery, Steam Trial Parties, &c., should write to the NATIONAL ASSOCIATION for EMPLOYMENT of REGULAR SAILORS, SOLDIERS and AIRMEN, Room 6, Dock-road, Chatham. Telephone, Chatham 10. P9274 A

FOUNDRY PLANT and EQUIPMENT MAKERS REQUIRE REPRESENTATIVES in Italy; connection amongst foundries and sound technical knowledge essential.—CONSTRUCTIONAL ENGINEERING CO., Ltd., Charles Henry-street, Birmingham. 6514 A

MECHANICAL ENGINEER REQUIRED for Service in Africa; Gas and Steam Engine experience, maintenance small plants, erection steel buildings, able to keep accounts. Tour 30 months, leave six months, housing, medical attendance, free passages. Salary £300 per annum. No sea-going men need apply.—Address applications, stating age, 6527, The Engineer Office. 6527 A

WANTED for Large Marine Engine Works on the North-East Coast, a thoroughly qualified DRAUGHTSMAN of good education, with experience in Marine Auxiliaries.—Address, stating age, salary required, and giving full particulars of experience and technical training, 6533, The Engineer Office. 6533 A

WANTED for the North Midlands, DRAUGHTSMEN, with experience in Steam Winders design and details, preferably with knowledge of Electric Winders. State age, detailed particulars of experience, and salary required.—Address, 6526, The Engineer Office. 6526 A

DRAUGHTSMAN WANTED, Country District, experienced and accurate in detailing, pumping machinery experience preferable but not essential; immediate start. State age, salary, and full particulars.—Address, 6552, The Engineer Office. 6552 A

DRAUGHTSMAN WANTED, Must be Fully Qualified in Structural Steel Work, Elevating and Conveying Machinery.—Apply, stating wages and full particulars, to Box T., W. H. Smith and Son, 53, Lichfield-street, Wolverhampton. P9412 A

DRAWING-OFFICE CLERK WANTED IMMEDIATELY, with good experience in D.O. routine work; must be capable of organising and operating efficiently up-to-date system.—Particulars of experience, age, and salary desired.—Address, "DRAWING," Wm. Porteous and Co., Advertising Agents, Glasgow. P9420 A

EXPERIENCED JIG and TOOL DRAUGHTSMAN REQUIRED for East Midland district. Must have experience in Machine Design.—Write, stating age, experience, and salary required, to Box 287, Willings, 30, King-street, Covent Garden, W.C. 2. 6561 A

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED, for North-East Coast. Must have had experience on Heavy Bridge Work, Foundations, Buildings, &c.; designing, preparing drawings for shops and estimating. State salary required. Others need not apply.—Address, 6305, The Engineer Office. 6305 A

HEAD DRAUGHTSMAN by Firm Manufacturing High-grade Medium and Small Machine Tools. Preference given to applicant with experience in American precision machinery.—Address, 6465, The Engineer Office. 6465 A

LEADING ENGINE DRAUGHTSMAN REQUIRED, with experience in Pipe Arrangements of Admiralty Destroyers. Only those having held similar positions and who are thoroughly experienced need apply.—Apply by letter only, stating age, experience, and salary required, to E. D. YARROW and CO., Scotstoun, Glasgow. 6583 A

LEADING TURBINE DRAUGHTSMAN REQUIRED, with experience in Admiralty Destroyers. Only those having held similar positions and who are thoroughly experienced in both calculations and designs need apply.—Apply by letter only, stating age, experience, and salary required, to T. D. YARROW and CO., Scotstoun, Glasgow. 6567 A

SEVERAL SENIOR and JUNIOR DRAUGHTSMEN WANTED for Aeronautical Work by S. E. SAUNDERS, Ltd., East Cowes, Isle of Wight. Apply, stating experience and wages desired. 6569 A

STRUCTURAL DRAUGHTSMAN, Used to Detailing Steel-framed Buildings, WANTED for temporary engagement in Westminster.—Address, stating age, experience, and salary required, P9421, The Engineer Office. P9421 A

WANTED for a British-owned Railway in Argentina, an ASSISTANT FOUNDRY FOREMAN under a English Foreman. Applicants must be fully conversant with modern methods of Machine, Plate and Hand Moulding and Core Making for Brass and Iron, covering general railway work, able accurately to estimate moulding times for such work and obtain maximum output of sound castings. Commencing salary £400 per annum.—Applications, giving full particulars of training, experience, age, &c., to be sent with copies (only) of testimonials, to Box "L. B. C.," c/o Davies and Co., 95, Bishopsgate, E.C. 2. 6590 A

## SITUATIONS WANTED

ADVERTISER (40), Skilled Mechanic, SEEKS SITUATION; life experience, good all-round man, experimental, light mechanical work, electrical experience, excellent references; London district preferred.—Address, P9400, The Engineer Office. P9400 B

B.SC., A.M.I.C.E., Excellent Connection, Own company, sales specialists, metal materials and plant for brick, concrete or steel structures, London, home and export, SEEKS progressive established MANUFACTURER'S AGENCY offering scope for initiative, energy and organisation. Commission only, providing business capable of extensive development. References.—Address, P9402, The Engineer Office. P9402 B

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## PATENTS

TO MANUFACTURERS OF MACHINE BEARINGS.—The PROPRIETOR of PATENT No. 20,767 of 1910 is DESIROUS of ENTERING into NEGOTIATIONS for the GRANT of LICENCES to manufacturers on royalty or otherwise or to TREAT for the SALE of the PATENT outright.—Particulars will be furnished on application by A. M. and WM. CLARK, 53 and 54, Chancery-lane, London, W.C. 2. 6581 H

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| Two Lancs | 30ft. by 8ft. 6in., | 160 lb. |
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DIESEL ENGINES, 300, 530, 800, 1200, and 1750 B.H.P., M.A.N., with or without dynamos, condition as new; about one-third market price; seen London. All spares for above sizes in stock.—RUCK DIESEL OIL ENGINES, Ltd., 70, Queen-street, E.C. 4. 6200 G

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3 SIX-WHEELED LOCOMOTIVES, complete with spares, 2ft. 6in. gauge; 60 STEEL TIMBER WAGONS, 2ft. 6in. gauge; 48 TIMBER YARD TRUCKS, 1ft. 6in. gauge; SPARE WHEELS and AXLES for wagons and trucks.

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Complete Machinery for Sawmill, including the following:—2 RANSOME HORIZONTAL LOG BAND SAWS; 2 DOUBLE-EDGER SAW BENCHES; 1 42in. CHAIN-FEED SAW BENCH; 3 CIRCULAR SAW BENCHES; 2 PENDULUM CROSS-CUT SAWS; COMPLETE SHARPENING MACHINERY; BELT-LACING MACHINE; EQUIPMENT for REPAIR SHOP; ELECTRIC LIGHTING EQUIPMENT; SHAFTING, BEARINGS and BELTING.

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Two 84in. by 10in. Double-drum WILLAMETTE LOGGING ENGINES and BOILERS, complete with necessary ropes, blocks, slings, and spare parts.

AERIAL ROPEWAY, by Ropeways, Ltd., London; total length 11,370 metres. Equipped with 229 wagons. Capacity 15 tons per hour. Operated by gravity. Emergency 12 H.P. Blackstone Oil Engine.

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FOR SALE, ONE Excellent HORIZONTAL COMPOUND CONDENSING STEAM ENGINE, 200 H.P., by Gimson, Stalybridge, in perfect order.—Can be seen running any time by appointment at R. RADCLIFFE and SONS (Mossley), Ltd., Squire Mill, Mossley, Lancs. 6513 G

FOR SALE, Splendid Robey SEMI-PORTABLE OVERTYPE COMPOUND ENGINE and BOILER, indicates 200 H.P., cylinders 12½in. and 21½in. by 18in. stroke, boiler insured 160 lb. original pressure, fitted superheater and pump. Only in use 15 months, equal to new. Will accept low price, immediate clearance; present day price over £2000.—GEO. COHEN SONS and CO., Ltd. 600, Commercial-road, E. 14, London. 6487 G

**For continuation of For Sale Advertisements see page 3.**

# A Seven-Day Journal

## Protection against Floods.

The carrying out of the works for the protection of Paris against floods has been nearly completed, so far as it is possible to ensure such protection independently of the undertaking to deepen the Seine, which is to be put in hand at some future date. Meanwhile, a considerable amount of work is to be done in the populous suburbs where the effects of floods are often more disastrous even than they are in Paris. An additional sum of 10 million francs is to be spent upon building walls along the Seine, raising the level of roads and connecting up the drainage system in such a way that the water will flow into the Seine below Argenteuil, and thereby relieve the mains higher up of a dangerous pressure. It is believed that these works will greatly minimise the risks of serious floods, but those risks will not be entirely avoided until the deepening of the Seine to Rouen and the removal of some of the obstructions in Paris facilitate the flow of the river through the city.

## The Edinburgh Railway Accident.

The facts concerning the fatal collision on the 28th ult. at Haymarket Station, Edinburgh, in which four passengers were killed, were investigated by Colonel Pringle on behalf of the Ministry of Transport last Friday. Between Waverley and Haymarket stations there is an intermediate signal-box known as Prince's-street Gardens, and the result of Colonel Pringle's inquiry resolved itself into the question, Was the down south line starting signal, as was maintained by the signalman, at "danger," and was it therefore irregularly passed by the driver of the second train, or was it, as decidedly affirmed by the driver, at clear? For the latter to be the case, the lock-and-block apparatus with which this section was equipped, must have been out of order, and of this fact, though pressed by Colonel Pringle, the several signalmen who gave evidence had no knowledge. The latter condition, further, would have meant an irregularity by the signalman in lowering his starting signal for a train which had not been accepted. Against the driver's version there must be set the fact that the signalman, as he admitted, prematurely lowered his home signal, and the driver found it "off" when he first sighted it. Rule 40 (*a*) says that when the starting signal is "on" the home signal must not be lowered until the train has been brought almost to a stand. This rule may conversely be read that when a home signal is seen to be at "clear" the starting signal also is "off." The driver was, however, positive that he saw the starting signal and that it was in his favour.

## The Lochaber Hydro-electric Scheme.

The first contract for the Lochaber hydro-electric scheme, which is being assisted by a trades facilities guarantee of £2,000,000, has just been placed, and tenders for the tunnelling work, which forms the second contract to be allocated, are now being submitted. The first contract is for the preliminary works and the construction of a reinforced concrete pier and a viaduct at Fort William, Inverness-shire, the contract being awarded to Messrs. Balfour, Beatty and Co., of London and Edinburgh, who competed with over a dozen of the largest firms specialising in civil engineering work. The driving of aqueducts through the solid rock of Ben Nevis and for a distance of 20 miles will involve tunnelling on a scale not hitherto attempted in this country. The scheme will transform what is now virgin forest land into an industrial area covered with large works for the production of aluminium and other metals.

## The Late Sir George Beilby.

The death of Sir George Beilby, which occurred in London last Thursday night, has removed one of our most industrious chemists and experts in the matter of fuel economy. He was born in 1850, and received his academic education at Edinburgh University. In 1869 he joined the staff of the Oakbank Oil Company, and thereby began a lengthy association with the Scottish shale oil industry. In the course of that association he introduced several important improvements in the distilling process, chief among which was a method for recovering ammonia from the spent retort material. Subsequently, he was actively connected with the Kastner-Kellner Alkali Company and the Cassel Cyanide Company. It was while engaged with the last-named company that his important researches on the low-temperature carbonisation of bituminous coal were begun. He had for many years interested himself in the economical use of fuel. He contributed in an important measure to the work of the Royal Commission on Coal Supplies in 1903, and was a member of Lord Fisher's Royal Commission on Fuel and Engines for the Navy, 1912–1913. The outbreak of the European War directed renewed attention to the finding of that Commission in the matter of developing a native source of oil supply by the adoption of low-temperature carbonisation of coal. In 1917 the Department of Scientific and Industrial Research established the Fuel Research Board, and appointed Sir George as chairman of that Board and as Director of the Fuel Research Station at East Greenwich. He was responsible for the design of that station, and when it was established spent all his time supervising its operation, for which work he refused to take any remuneration. Every patent which he took out during his tenure of this office, he presented to the Government, and he declined even to accept a refund of his personal expenses. He retired from the work last year. Outside his work on fuel, he devoted close attention to certain aspects of metallurgy, contributing notably to the theory of flow in metals.

## The Jutland Narrative.

In connection with the publication of the official "Narrative of Jutland," it may be recalled that Captain Harper's version of the battle, which it was originally intended to give out some three years ago, was held up at the last moment, owing to the receipt of new evidence from the German side, according to a statement made in Parliament at the time. Eventually the Harper version, or part of it, was merged into the narrative which has now made its appearance. The nature of the "new evidence" is indicated by copious extracts from Von Hase's "Zwei Weissen Völker," which are embodied in the text. The Engineer may claim to have been the first journal in this country to perceive the great importance of this book by the former gunnery officer of the Derfflinger. Published at Leipzig early in 1920, it was reviewed in our columns at great length, the notice extending over four successive issues, from February 20th to March 12th of that year. The historical value of the work lay in its careful record of gun ranges and evolutions at critical stages of the engagement. These data were based upon memoranda which Commander von Hase had arranged beforehand to be jotted down at every fighting station in the Derfflinger so long as the action continued. Thanks to this record, it has been possible to check the more casual and less complete notes that were available from other sources. Von Hase gave a vivid description of the loss of the Queen Mary, a disaster to which the firing of his ship mainly contributed, and further details of this and other tragic episodes of the action are found in the Admiralty narrative. There is also a full list of the hits made with large-calibre shell on vessels in both fleets. The battle-cruisers, which bore the brunt of the fighting, naturally suffered most, but our Fifth Battle Squadron, consisting of four "Queen Elizabeths," also came in for heavy punishment. It is a curious fact that the Lion, which probably received many more hits than the Queen Mary, should have come through the ordeal afloat and still in fighting trim, while her consort of identical design succumbed very quickly.

## A Wireless Beam Station.

A White Paper just issued contains the text of an agreement between the Postmaster-General and Marconi's Wireless Telegraph Company with regard to the construction of a wireless telegraph station working on the beam system. It is to be suitable for communication with Canada and capable of being extended so as to make it possible to send messages to South Africa, India, and Australia. A Treasury minute accompanies the agreement and records the approval of the Lords Commissioners to the scheme. It is explained in the minute that various safeguards are included in the agreement to prevent any excessive charges. After consultation with the Marconi Company the Postmaster-General is to fix such rates of charge to the public for the transmission of telegrams as shall in his opinion be calculated to attract the largest possible volume of traffic with due regard to economic considerations. The rates to and from Canada are not to exceed the existing rates, and those to and from other parts of the Empire are not to exceed two-thirds of the cable rates now in force.

## A New French Liner.

The new 17,000-ton twin-screw liner De Grasse, built by Cammell, Laird and Co., Limited, at Birkenhead, was handed over to the Compagnie Générale Transatlantique on Monday last, after the conclusion of successful builders' sea trials, which were continued over the week-end. The De Grasse was launched at Birkenhead on February 23rd, and she has the following leading dimensions:—Length between perpendiculars, 550ft.; breadth moulded, 71ft.; depth moulded, 46ft. 6in.; gross tonnage, 17,000 tons; displacement, about 21,700 tons, at 28ft. mean draught. Her accommodation includes cabins and state rooms for 399 first-class passengers, with third-class cabin accommodation for 796 passengers, and open berth accommodation for a further 916 third-class passengers. The propelling machinery is designed for a speed of 17 knots, and comprises two sets of Parsons turbines with single reduction gearing. Each set of machinery consists of one high-pressure and one low-pressure turbine coupled through a flexible coupling to a separate pinion. Compound astern turbines incorporated in the casings of the ahead turbines are employed, and Michell thrust bearings are fitted. The condensers are worked on the Weir closed-feed system. Steam is supplied by ten single-ended cylindrical boilers, designed for 200 lb. working pressure, and each provided with four furnaces arranged for burning oil fuel on the Wallsend-Howden system. The auxiliary machinery is of the latest type, and includes turbine-driven extraction and boiler-feed pumps. The new liner will be used on the company's Le Havre–New York service.

## Co-ordinated Electricity Supply.

Commenting upon the Government's proposal to introduce a Bill to secure greater co-ordination between national and local interests in the supply of electricity, Mr. A. Chaddock, the chief electrical engineer at Birmingham, recently pointed out that considerable progress had been made in that direction in connection with the electrical development in the South-West Midlands, in which Birmingham is situated. The scheme, he said, was actually in operation and a definite responsibility for the electrical development in the various areas was placed upon the Corporation of Birmingham, the Shropshire, Worcestershire and Staffordshire Electric Power Company, and the Leicestershire and Warwickshire Power Company. A joint advisory committee had been appointed by the Birmingham Corporation and the Shropshire Company, and its function would be to see that the district comprising the South Midlands was adequately supplied with electric current. Some years, Mr. Chaddock added, must elapse before full effect could be given to the scheme, but considerable headway had already been made.

## The Australian Cruisers.

The two cruisers which the Australian Government has decided to add to its Navy are providing food for a considerable amount of controversy in the Commonwealth. The subject of debate is whether the vessels should be built in Australia or in this country. The Government holds the view that to build both at Cockatoo Dockyard would mean the provision of special temporary equipment and would create employment for a considerable number of workers who afterwards would become unemployed. A British offer has been received by the Australian Government covering the construction of a cruiser of the approved type for £2,100,000, with delivery in twenty-seven months. If both the cruisers were placed with the same firm each could be built for £2,050,000 and delivery of the second could be given in thirty months. Estimates prepared as to the cost of building one of the cruisers in Australia vary from £3,300,000, the Shipping Board's figure, to £3,960,000, the Naval Board's figure, and the period to delivery from thirty to thirty-nine months. The Government is reluctant to deprive the local dockyard of work, but with a million or possibly nearly two million pounds per cruiser in favour of placing the order in this country it is naturally looking at the situation from all angles before coming to a definite decision.

## Closing of a Bolton Steel Works.

The old-established works of the Bolton Iron and Steel Company, Limited, which in 1903 was taken over by H. Bessemer and Co., Limited, is to be closed down. The Bessemer Company announces its intention of concentrating its business at its Sheffield works, and the reason assigned for shutting down the Bolton plant is the increased competition and the high cost of production. By arrangement with Messrs. Bessemer, the Bolton works have been acquired by Thos. W. Ward, Limited, of Sheffield, but it does not seem likely that the plant will be run again. In all probability the Siemens furnaces and the forge equipment, together with the machine shops, will be dismantled and sold. It is regrettable that the town of Bolton will lose the employment which was provided by this old-established industrial undertaking. The site of the works is, however, a central one, and it possesses considerable value, which should give it an important place in the future development of the town.

## Safety in Mines.

An appeal has been issued by the Secretary of Mines—Mr. E. Shinwell—for a joint effort to effect a reduction in the number of accidents in mines arising directly from falls of the roof and sides. In his letter, which has been sent to owners and mine officials and to the secretaries of various mining associations, the Secretary of Mines points out that over 500 persons are killed each year by such accidents, which figure represents more than the total number of deaths underground arising from all other causes. While some accidents arising from falls would at present seem to be unavoidable, a large reduction in the number of casualties would be secured if the systematic timbering and spragging of roadways and working places, as provided for in the Coal Mines Act, were more faithfully carried out. The letter draws attention to points with regard to timbering which the inspectors of mines regard as important, and care on the part of the workmen and instruction and close supervision by officials are enjoined. At the present time a Committee of the Safety in Mines Research Board is investigating possible means of reducing the number of mine accidents directly attributable to falls of roof or sides.

# The British Empire Exhibition.

## ENGINEERING EXHIBITS. No. XVI.*

### GENERAL ENGINEERING EXHIBITS.

DANIEL ADAMSON AND CO., LIMITED.

THE central exhibit on a very attractive stand by Daniel Adamson and Co., Limited, of Dukinfield, near Manchester, is a turbo-compressor coupled to an Adamson-Rateau steam turbine. This combination represents the firm's latest practice in this branch of engineering. The normal duty of the set is 10,000 cubic feet of free air per minute, at a pressure of 100 lb. per square inch. A general view of the complete plant is given in Fig. 310, a second view with the top casings removed being given in Fig. 311. Fig. 312 shows the compressor rotor removed; Fig. 313 one of the compressor wheels before the end plate is riveted on; and Fig. 314 a compressor diaphragm.

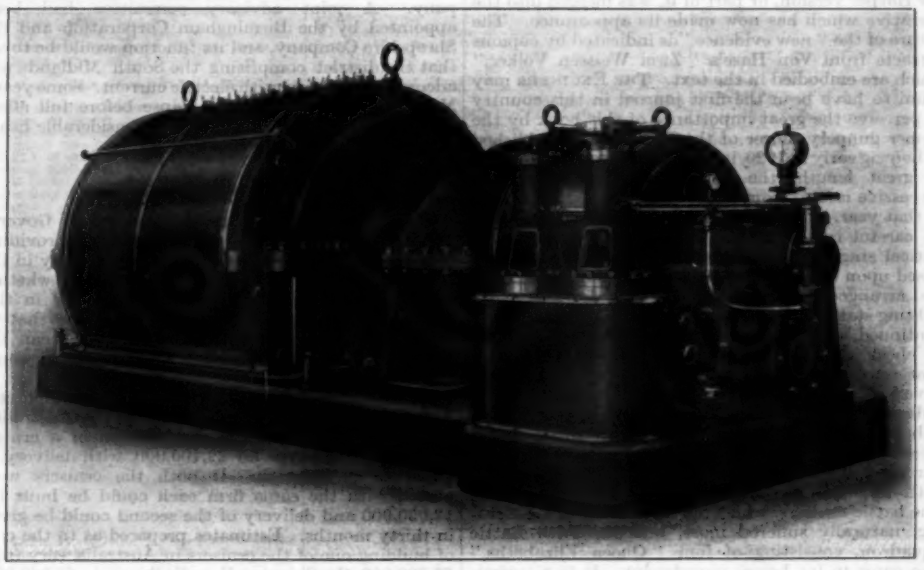


FIG. 310—STEAM TURBINE AND TURBO-COMPRESSOR—D. ADAMSON

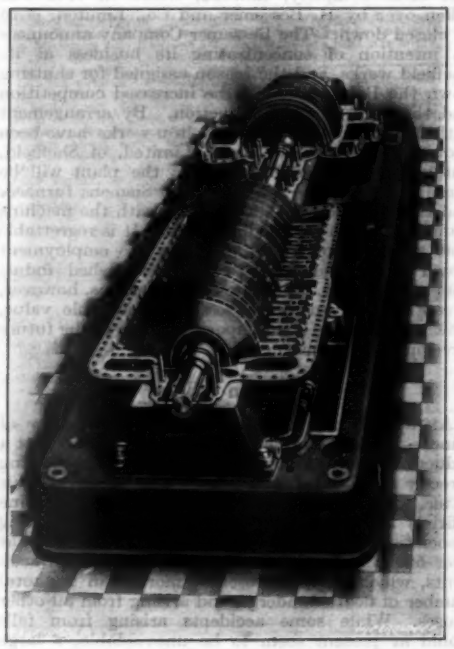


FIG. 311—TURBO-COMPRESSOR WITH COVER REMOVED

One of the important features of this compressor is the system of inner cooling, the intermediate walls being cored out and provided with large water spaces. Thus, the employment of an intermediate cooler is avoided. The water spaces are easy of access, and can be cleaned while the compressor is running. The makers claim that this system is better than external cooling—first, because a higher efficiency is obtained, owing to the elimination of the flow losses through the channels of the external coolers, the heat generated at each stage being dissipated at its source; and, secondly, because there is no danger of leakage into the air system.

Two different methods of control are employed, one to meet conditions when the demand for air varies between approximately 70 per cent. and 110 per cent. of the normal capacity, and a second to meet the conditions when the demand for air varies between no load and 110 per cent. load. In the former case, the regulation of the air suction is carried out automatically by the air pressure in the main pipe acting on the compressed air regulator. A decreased air delivery causes a rise in air pressure, and this increase actuates an air regulator, which, in turn, operates the turbine throttle valve, causing a drop in speed commensurate with the reduced air delivery. An increased air delivery, on the other hand, operating through the air regulator, has the reverse effect, *i.e.*, it increases the turbine speed. Hand adjustment is also provided, in addition to an automatic regulation, which controls the amount of air delivered between approximately 70 to 110 per cent. of the normal capacity. If the demand for air falls below the first-named limit, the atmospheric valve opens automatically and the surplus air escapes.

Under the second method of control referred to above, when the volume of air delivered is decreased, the regulator valve comes into operation, as in the first arrangement, but a further decrease brings into action an oil-operated suction valve, which closes the suction main. At the same moment a non-return valve closes in the air delivery main, thus cutting the compressor off from the air system. Under such conditions, the suction valve permits a small quantity of air at atmospheric pressure to circulate to ensure sufficient cooling of the compressor, when the latter is running for long periods under non-delivery conditions. The load on the machine is therefore reduced to a minimum, and it will run in that condition until the pressure in the system has dropped a certain amount, when the suction valve reopens and normal working is restored. The system of suction governing is shown in Fig. 315.

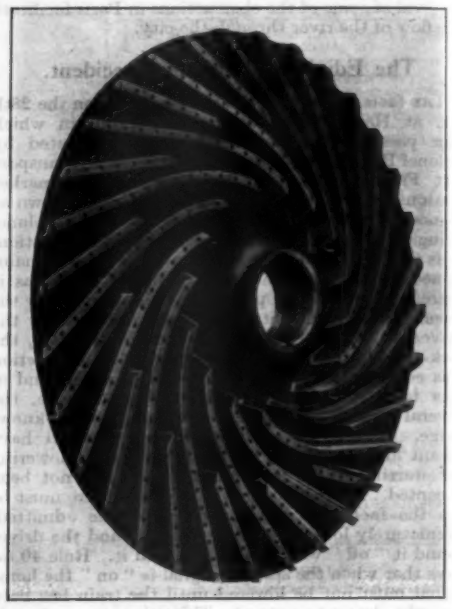


FIG. 313—COMPRESSOR WHEEL

The change-over mechanism consists of a relay piston, which controls an oil pressure valve. The relay piston is ordinarily retained at its lowest position by a spring. When in that position the valve permits pressure oil to flow by the pipe *a* to the lower side of cylinder, the piston of which is connected to the suction valve. The valve is thereby raised, and the suction is full open. If, however, the pressure in the compressed air main rises, the relay piston is forced upwards, the valve changes the direction of flow of the compressed air, and the suction valve descends under the influence of the pressure oil, which now passes down the pipe *b* and forces the suction valve piston downwards. Ordinarily, when the pressure has fallen about 7 lb., the normal position is restored.

When starting up, the relay piston can be held in its top position by hand adjustment, thereby closing the suction valve. On the spindle of the suction valve is fixed an air escape valve, which opens as the suction valve closes, and when the non-return valve in the discharge pipe closes

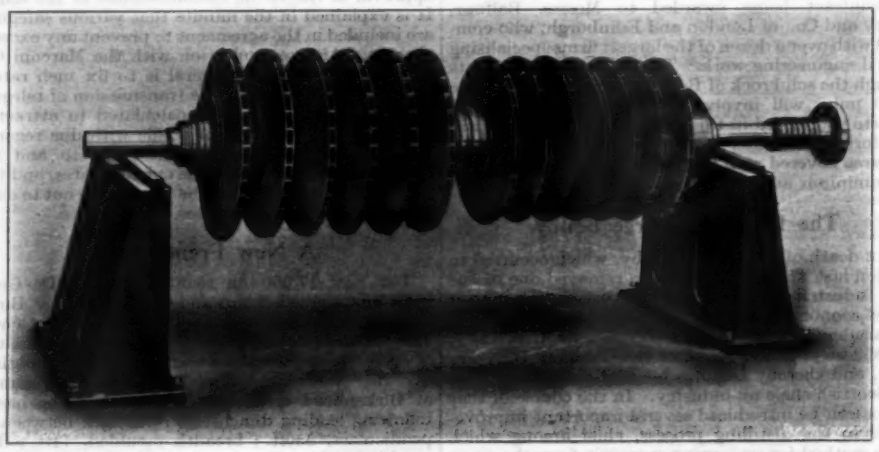


FIG. 312—COMPRESSOR ROTOR—D. ADAMSON

* No. XV. appeared August 1st, 1924.

it allows the compressed air to escape from the machine.

The turbine is of the Rateau design for high pressures, as supplied by Messrs. Adamson, a special feature of whose turbines is the blading. Each blade, with its shrouding and roots, is milled from solid nickel steel bar, a method of construction which, after fifteen years' experience, the firm finds to be the

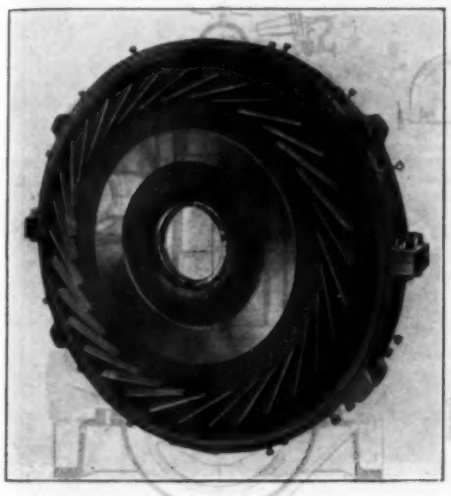


FIG. 314—COMPRESSOR DIAPHRAGM

strongest and lightest, while free from erosion troubles, provided the correct ratio of steam velocity to the moisture content is used. The rotor shafts are made from Siemens-Martin steel forgings, annealed, rough-machined and re-annealed, then finish-machined and ground to exact size from end to end. This method of construction is claimed to give very great accuracy, and to prevent undue stresses being set up when pressing

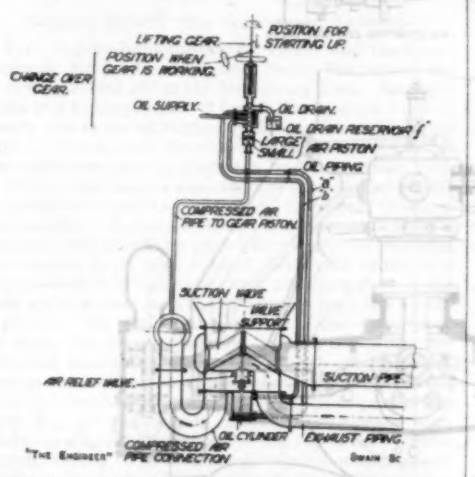



FIG. 315—AIR-SUCTION GOVERNING ARRANGEMENTS

the discs on to the shaft. The discs are held in position by sunk keys and end nuts. They also are of Siemens-Martin steel, forged out of the solid and submitted to the same processes as the shaft.

This firm also exhibits a model of a pneumatic sewage ejecting plant, of which we give an illustration in Fig. 317. The plant comprises an electrically-driven air compressor, which is coupled to an ejector

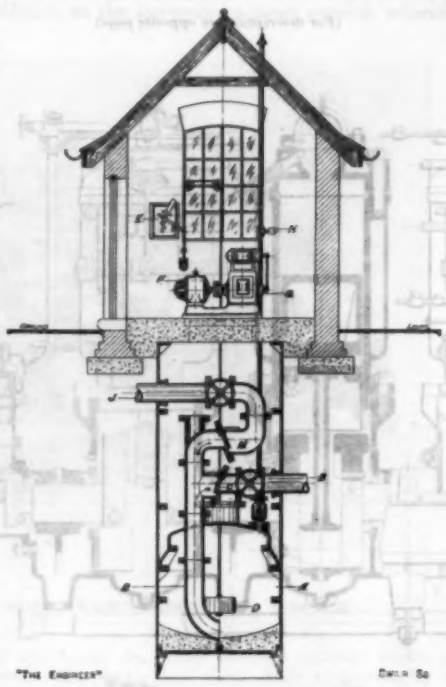



FIG. 317—SEWAGE EJECTOR—D. ADAMSON

contained in a chamber, which is arranged below the ground at a suitable level. In operation the sewage flows by gravity into the ejector body A, through the inlet pipe B, which has in it a hinged flap valve C, and raises the float D, which is connected to the switch E. As the sewage rises and falls in the ejector, the float moves up and down, and this movement operates the switch, thus making or breaking the circuit of the motor F, which drives an air compressor. On the air pipe connecting the compressor to the ejector, there is a magnetically operated valve H, which is controlled by the float switch. When the motor is started, this valve is closed to the atmosphere, and when the motor stops, the valve is opened again. This action is brought about by means of a switch opening and closing the circuit to a solenoid which operates the valve. As soon as the compressor starts working, compressed air is driven into the ejector on to the surface of the sewage, closes the flap valve C, and drives the sewage from the ejector past an outlet flap M into the outlet pipe J, through which it is forced to the desired outfall. The ejector continues to discharge its contents until the float opens the switch contacts, thereby stopping the motor and opening the exhaust valve H. In this manner the compressed air remaining in the ejector is exhausted into atmosphere, and the weight of sewage in the rising main closes the outlet valve M. This cycle of operations is repeated automatically as long as the sewage continues to flow into the ejector. For continuous operation, two or more of these ejectors may be used, and an electro-mechanical valve switches the compressed air on to one or other of them alternately. From the foregoing description, it will be noted that in this system the power used is in proportion to the load, and the storage of air in receivers with all the necessary piping and joints is dispensed with. The pressure and volume of air used are directly in proportion to the volume of liquid dealt with, and as the head of liquid on these ejectors is comparatively small, the air compressor may be of a low-pressure type.

### HOLDEN AND BROOKE, LIMITED.

In the model colliery underground there is installed a multi-stage motor-driven centrifugal pump, made by Holden and Brooke, Limited, Manchester, which is capable of delivering 600 gallons of water per minute against a total head of 560ft., when running at a speed of 1450 revolutions per minute. In Fig. 316 is given an end elevation and plan of the plant, together with the dimensions from which the smallness of the space occupied will be noted. Fig. 318 is a sectional elevation of the pump itself, which is of the four-stage type. The impellers are accurately balanced, both individually and collectively, on their shaft before assembly. Each set of guide passages is cast in one complete ring, and separate from the pump body, so that the passages may be worked up to a smooth surface for the sake of efficiency, and at the same time be easily renewable. The various sections are secured in place by the main bolts, thus obviating the employment of numerous screws in the body of the pump. To facilitate renewal, the bodies are fitted with removable rings in all parts subject to wear, owing to the running of the impellers. The stuffing-box in the suction cover is water sealed, and is supplied with water taken from the periphery of the first impeller, thus ensuring a supply as free from grit as possible. In the suction end bearing is embodied a special device which effectively prevents water passing along the shaft into the bearing, and also acts as a combined water and oil thrower, avoiding the possibility of oil getting out of the bearing and water getting in while the pump is running, in case of the bearing housing becoming flooded, owing to a stoppage in the pipe which drains the housing. The delivery end bearing is of the internal type, which dispenses with a stuffing-box working under high pressure, and at the same time retains the advantage of an external bearing. This bearing has a renewable bush, and the water required for balancing the end thrust of the iron pillars is made to pass round the outside of this bush. The bearing being constructed with a closed

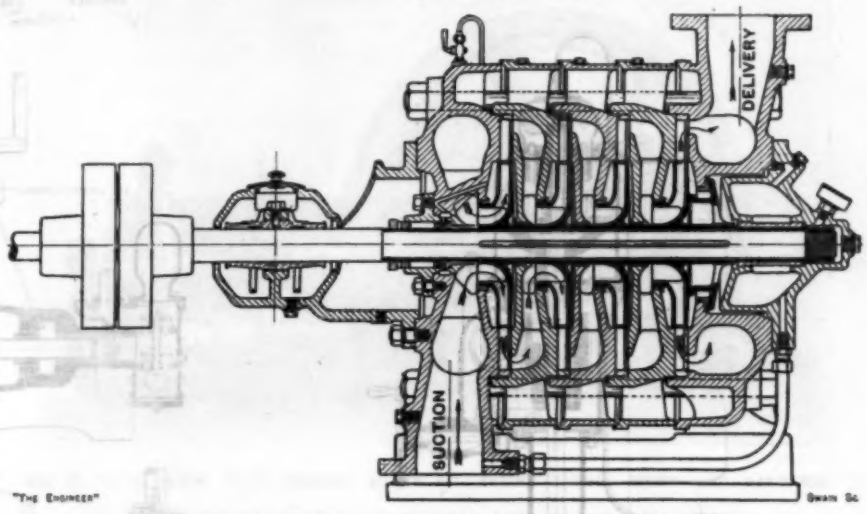



FIG. 318—SECTION THROUGH CENTRIFUGAL PUMP—HOLDEN AND BROOKE

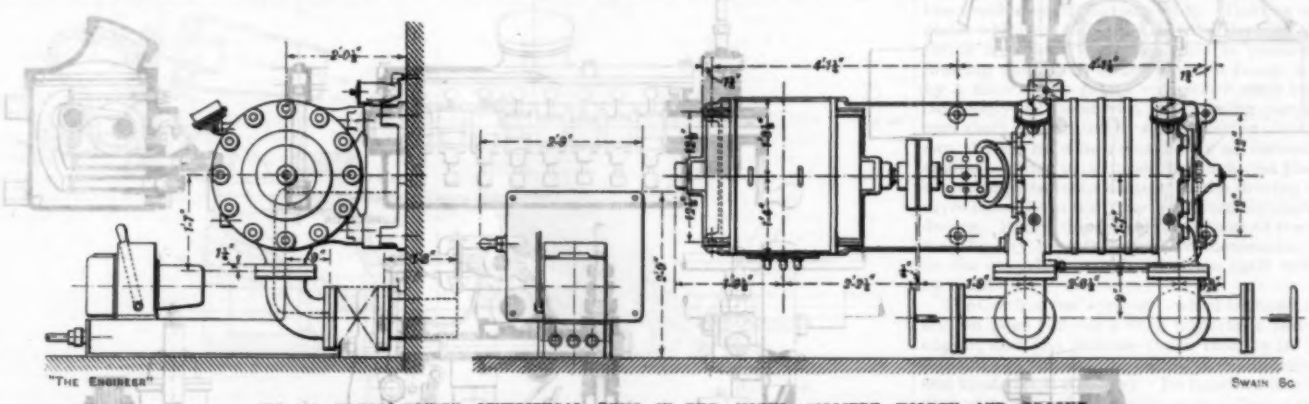
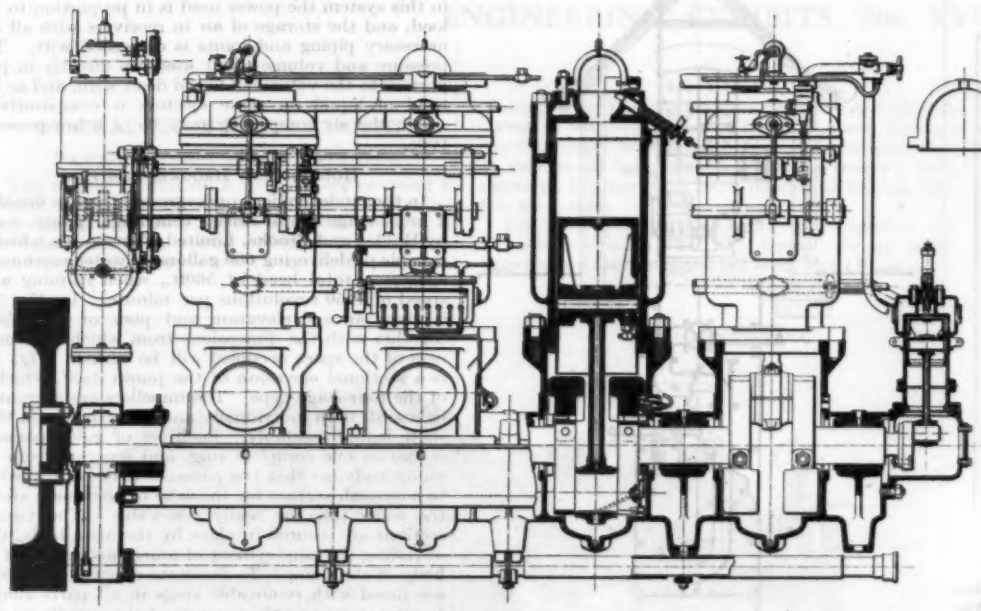


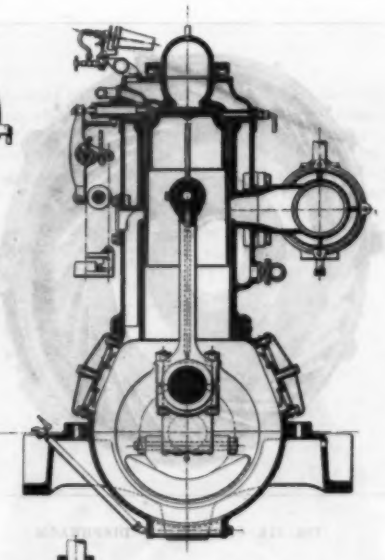

FIG. 316—MOTOR-DRIVEN CENTRIFUGAL PUMP IN THE MODEL COLLIERY—HOLDEN AND BROOKE

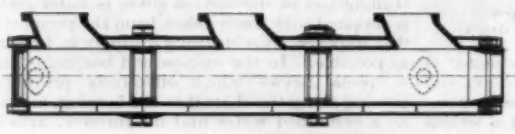
# 72 B.H.P. MARINE-TYPE HEAVY OIL ENGINE

NORRIS, HENTY AND GARDNERS, LIMITED, PATRICROFT, ENGINEERS

(*For description see opposite page*)



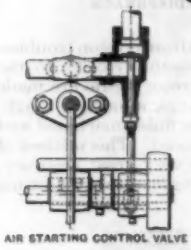




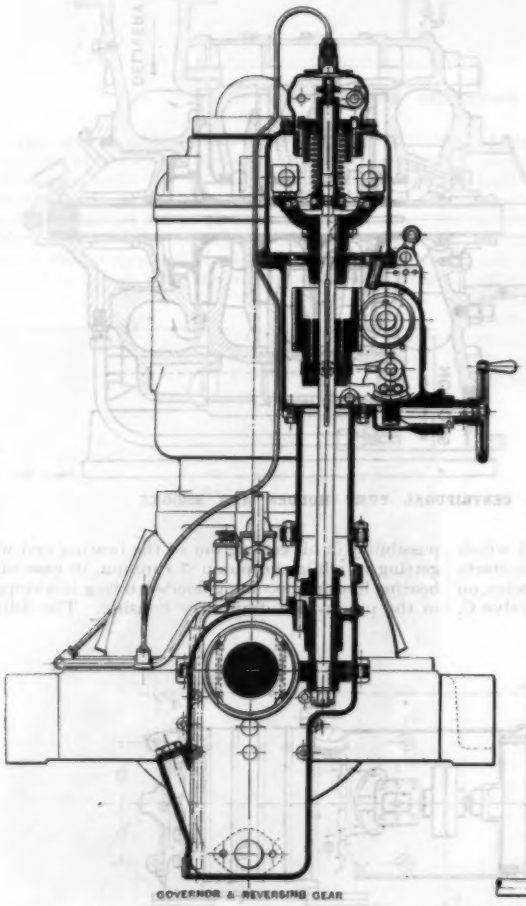
EXHAUST MANIFOLD

WATER STRAINER

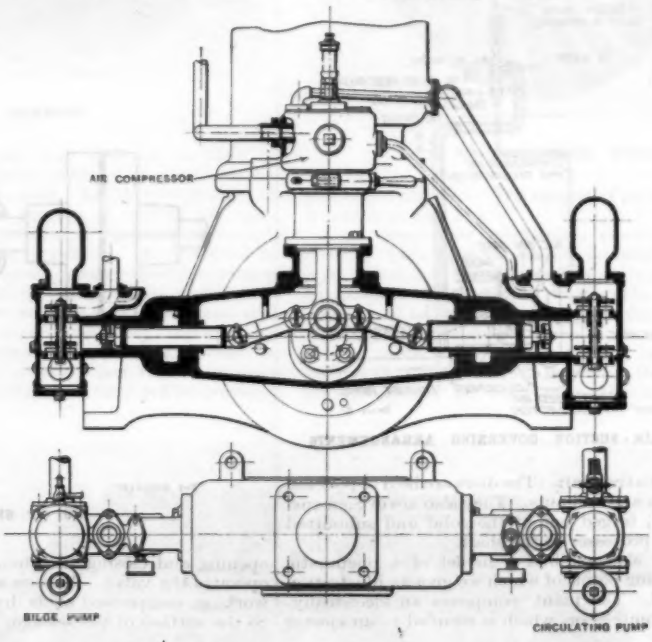
FUEL STRAINER



AIR STARTING CONTROL VALVE



GOVERNOR & REVERSING GEAR

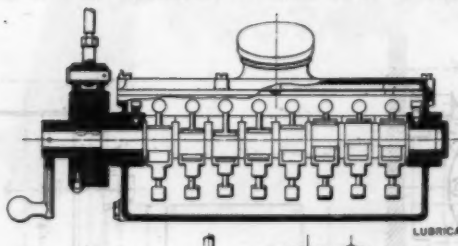


AIR COMPRESSOR

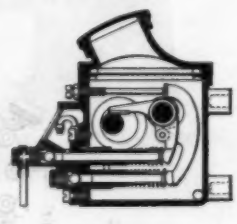


BILGE PUMP

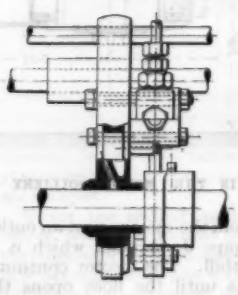
CIRCULATING PUMP

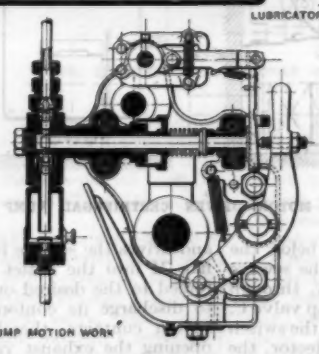


LUBRICATOR

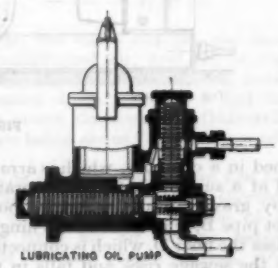


SPRAYER





FUEL PUMP MOTION WORK



LUBRICATING OIL PUMP

end, permits no leakage of water along it, and any lubricant which passes out of the bearing mixes only with the balance water which passes away to the drain. The end thrust is balanced hydraulically. In addition to the small space occupied and the low initial cost, this type of pump requires very small expense in connection with foundations. It is flexible under varying conditions of operation and can be operated against a closed delivery valve without having to by-pass water from the delivery to the suction. The pump has an efficiency of 72 per cent., and the brake horse-power at the coupling is 141.5, the motor being rated at 170 brake horse-power to allow for overloading.

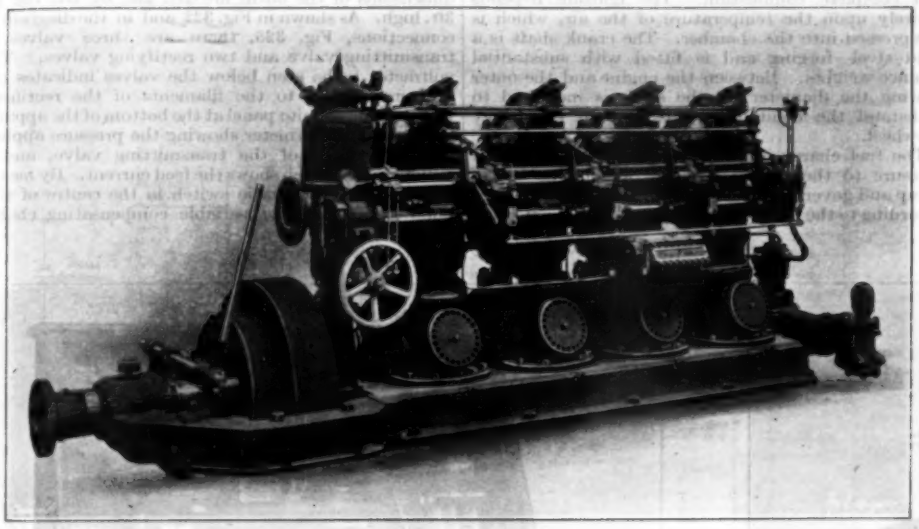


FIG. 319—72 B.H.P. MARINE-TYPE HEAVY OIL ENGINE—NORRIS, HENTY AND GARDNERS

### Norris, Henty and Gardners, Limited.

Five engines built for Norris, Henty and Gardners, Limited, by L. Gardner and Sons, Patricroft, are shown on Stand 187 in the Machinery Hall. Amongst them is a four-cylinder 72 brake horse-power vertical heavy two-cycle oil engine of the marine type, fitted with a clutch and direct-reversing mechanism. It has cylinders 8¼in. in diameter by 9½in. stroke, runs at 400 revolutions per minute, uses the heaviest grades of cheap fuel, and can be started from cold within a few minutes. A general view of it is given in Fig. 319, and sectional details on page 152. It will be seen that the engine is of the typical two-cycle crank-case compression hot-bulb type, with the lower part of the bulb water cooled, and the upper part kept hot by the explosion. To obviate the leakage of the compressed air from the crank chamber, special air joints are provided near the main bearings, with spring-loaded sealing washers of large diameter, positively driven from the crank webs. The dome, or upper part of the bulb, Fig. 320—to which reference has already been made—is a light casting clamped on top of the cylinder breech. Owing to the comparatively low working temperature at which it is maintained, its life approaches that of the engine itself. The pistons are tapered to allow for varying expansion when in operation by an amount which has been ascertained by long experience, and "easing by hand" is eliminated. The gudgeon pins are of hardened steel, finished by grinding, and are fixed on the piston. The connecting-rods are cut from solid forgings. At the big end the bearing is a bronze shell lined with white metal; whilst the small end is fitted with a phosphor bronze bush. They are bored throughout their length for lubrication of the gudgeon pin. Both ends of the rods are lubricated by a centrifugal oiler, which receives charges of oil from a multi-point lubricator.

A vertical countershaft, driven from the crank shaft through helical gears, operates the cam shaft and the lubricating pump. It also carries the governor and reversing gear. The centrifugal governor is entirely enclosed, and all its working parts are lubricated from the main "flow and return" system. When the engine is applied to marine purposes, in addition to the governor, a hand control, whereby the speed may be varied between extreme limits, is fitted. The horizontal cam shaft is driven by a skew pinion on the vertical shaft. This pinion may be moved axially on the shaft by a lever and quadrant, as shown in Fig. 319. Such movement obviously affects the relative position of the crank shaft and cam shaft, and can therefore be employed to vary the moment of injection or to reverse the engine.

Situated at the forward end of the engine is an auxiliary crank case, which carries an air compressor, circulating pump, and, when necessary, a bilge pump. The air compressor is built in the engine and is driven direct from the engine crank shaft, the cylinder being water jacketed and cooled from the main cooling system. The circulating and bilge pumps shown in the detail drawings are of the plunger type, and air chambers are fixed on both delivery and suction sides. The rams are of gun-metal and the pump cylinders have liners of the same metal.

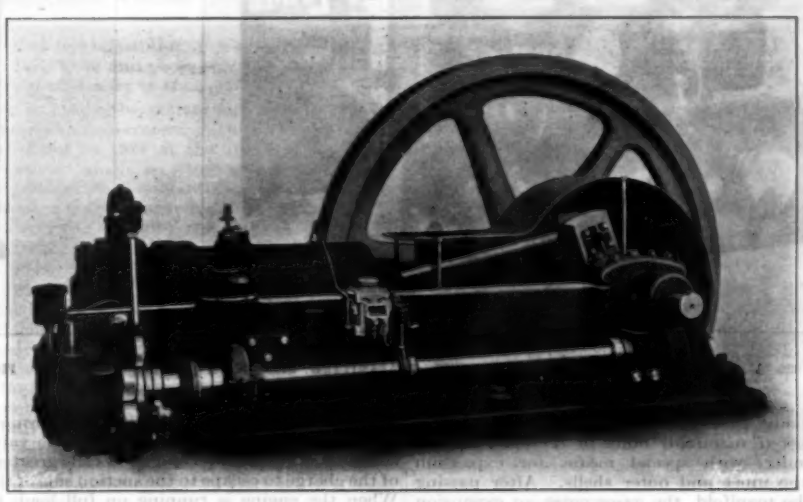


FIG. 321—29-31 B.H.P. COLD-STARTING HEAVY OIL ENGINE—NORRIS, HENTY AND GARDNERS

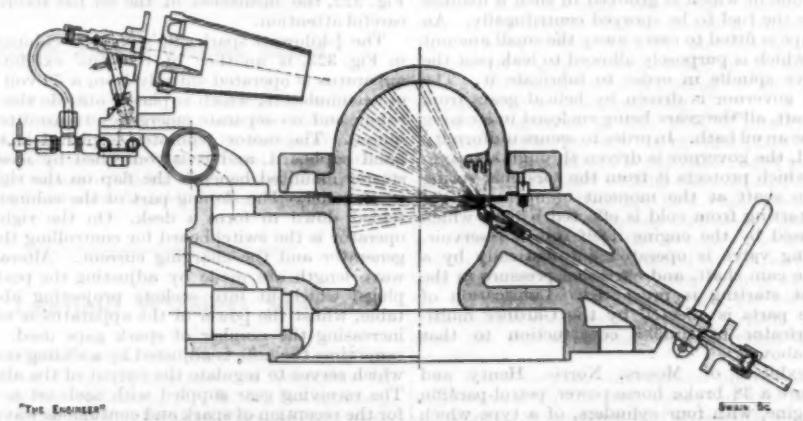



FIG. 320—SECTION THROUGH BULB AND SPRAYER—NORRIS, HENTY AND GARDNERS

The reversing and starting mechanism resembles somewhat that of a steam engine, the complete reversing operation being performed by four turns of a hand wheel, during which the following operations take place automatically:—The angular position of the cam shaft is changed from ahead to astern, or *vice versâ*, by the sliding skew pinion, as explained above. The first turn or so puts out of operation the fuel injection pumps, and the engine slows down. Towards the end of the third turn the fuel pumps are brought into action again simultaneously with the compressed air starting valves, which latter admit a puff of compressed air to the cylinders, causing the engine to start in the opposite direction. At the end of the fourth and last turn, the air valves are put out of action, and the engine continues to run under full conditions.

Lubrication of the parts of the engine is effected by two distinct systems, one a flow and return system, and the other a multi-point lubricator. The former lubricates the crank shaft bearings and all other parts external to the crank case and cylinder. The lubrication ram pump is situated on the casing of the vertical countershaft, a cam on the latter operating a spring-controlled ram, which forces the oil to the various parts by means of a service pipe. The pulsations of this pump are damped by an air chamber fixed on the suction side of the pump, and an anti-pulsator valve on the delivery side—see page 152. This valve also serves to control the oil pressure throughout the system. The multi-point lubricator—shown in detail on page 152—delivers to each point a pre-determined charge, measured in drops per minute, from the sight-feed nozzle. Each point to be lubricated is served by a complete and separate unit, consisting of a double-ram pump, with its pair of actuating levers. The lower of the two pumps measures the charge of oil and delivers it by way of a sight-feed nozzle into a well situated over the inlet of the upper pump, into which it flows by gravity and suction. The upper pump then forces the measured charge to the desired point. The upper pump ram has a constant stroke, and the lower ram has a variable stroke, which is controlled by the adjusting screw shown, whereby the stroke of the lever is limited. The head of the screw being outside the casing, this adjustment can be carried out while the lubricator is at work. Each pump is separately adjustable. The cam shaft and cams are in one piece, made from a steel bar, and the cams are equally phased throughout one revolution of the cam shaft. The box has a cover plate, which extends over its whole length. This cover forms a filtering chamber, and is provided with a filtering mesh. In addition, each pump is protected by a filter. The pump valves are steel balls, which can easily be withdrawn for cleaning purposes. The cam shaft is operated by an oscillating clutch mechanism, driven by a link worked by an excentric on the engine, so that it is turned through one phase during each complete reciprocation of the driving link. The drive from the clutch case is effected through a friction device. Hence the rotary movement of the cam shaft may be anything from zero to maximum. A handle on the cam shaft enables the cam shaft to be rotated by hand.

The Gardner fuel sprayer—which is shown in Fig. 320 and on page 152—is a very important feature of the engine, and the makers claim that by its means the difficulty of running under varying conditions of load and kind of fuel is solved. Its function is to direct the geometric axis of the spray on to different parts of the surface of the hot dome, which is effected at will, either while the engine is running or at rest, and with the same facility as turning the lever of a cock. In practice it is found that the three positions shown by the three sets of broken lines in Fig. 320 suffice for all conditions.

The sprayer comprises a hollow spindle fitted with a spring-seated ball valve, and a nipple of special formation. Each cylinder is served by a separate

fuel pump, which measures the charge of fuel corresponding to the load on the engine, and forces it under high pressure to the sprayer. The amount of the charge depends upon the position of a hard steel wedge interposed between the pump ram and the rocking lever, which position is controlled by the governor. The wedges are flexibly connected to the drop links from the governor, in such a manner that the latter has always perfect freedom of action, notwithstanding that each wedge in succession is momentarily immovable while operating its pump.

The quick-starting burners—shown in section in Fig. 320—are permanently attached to the engine. In principle, each burner consists of a small spray of petroleum or petrol across which blows a current of air derived from the compressed air system. The burners are lighted as instantaneously as a gas burner, and are as instantaneously extinguished.

The exhaust gases from the cylinders pass into a water-jacketed manifold, built in sections, one to each cylinder, with special means for expansion between the inner and outer shells. After passing through the manifold, the gases enter an expansion chamber, which is separate from the engine.

Another engine shown, which we have selected for detailed illustration—Fig. 321—is a 29–31 brake horse-power heavy oil engine of the cold-starting variety, and designed to run at a speed of 240 revolutions per minute. It operates on the four-stroke cycle. The cylinder, with a bore and stroke 9½in. by 17in., forms part of the bed structure, and is

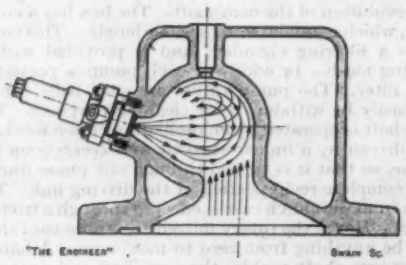


FIG. 324—WATER-COOLED CYLINDER BREECH—N. H. & G.

supported for practically the whole of its length. The liner is entirely separate from the cylinder and breech. It is perfectly symmetric and without bolts, the pressure and water joints being made by the clamping action of the breech. The forward end of the liner fits in the bore of the cylinder, and is free to expand and contract by means of the usual rubber rings. The cylinder breech is water jacketed and contains the combustion chamber, valves and injector sprayer—as shown in the sectional view herewith. It is provided with one large door and several smaller openings for the examination and cleaning out of the water space. The combustion chamber is of special formation, the throat which communicates with the engine cylinder being tangential to the circular form of the chamber, as also is the axis of the fuel injector—Fig. 324. By this method of construction, the stream of air which is forced into the combustion chamber during compression and injection induces a whirling action of the fuel spray and complete combustion. The ignition depends entirely upon the temperature of the air, which is compressed into the chamber. The crank shaft is a solid steel forging and is fitted with substantial balance weights. Between the engine and the outer bearing the diameter of the shaft is increased to withstand the bending stresses due to the heavy fly-wheel.

The fuel charge is measured and delivered under pressure to the fuel sprayer by a combination of pump and governor valve, which graduates the charge according to the load on the engine, the governor valve being controlled by the centrifugal governor. When the engine is running without load, the valve opens almost to its maximum and allows the greater portion of the charge to escape to the suction side of the pump. When the engine is running on full load, however, the valve opens only slightly, and most of the fuel charge is injected into the cylinder. The whole of the governing mechanism is enclosed in a housing, and has to be kept well lubricated. The feature of this system is that no matter how the charge may be graded from no-load to maximum, the beginning of the charge always takes place at the same point in the cycle of operations. The sprayer consists of a spring-loaded needle valve seating upon two hardened steel dies, one of which is grooved in such a manner as to cause the fuel to be sprayed centrifugally. An oil drain pipe is fitted to carry away the small amount of fuel oil which is purposely allowed to leak past the needle valve spindle in order to lubricate it. The centrifugal governor is driven by helical gears from the cam shaft, all the gears being enclosed in a casing which forms an oil bath. In order to secure uniformity of its speed, the governor is driven through a spring-coupling, which protects it from the torsional spring of the cam shaft at the moment of operating the valves. Starting from cold is effected by air, which is compressed by the engine itself into a reservoir. The starting valve is operated automatically by a cam on the cam shaft, and excessive pressure in the cylinder at starting is prevented. Lubrication of the engine parts is effected by the Gardner multi-point lubricator of similar construction to that described above.

Other exhibits of Messrs. Norris, Henty and Gardners are a 38 brake horse-power petrol-paraffin marine engine, with four cylinders, of a type which is being used by shipping companies for lifeboat propulsion, emergency lighting sets, &c.; a single-cylinder vertical 3 brake horse-power petrol-paraffin engine; and an 18 brake horse-power heavy oil engine.

## ELECTRICAL ENGINEERING EXHIBITS.

### Siemens Brothers and Co. Limited.

The 1½-kilowatt continuous wave wireless transmitter, shown in Fig. 322, is to be seen on the stand of Siemens Brothers, of Woolwich. The overall dimensions of the outfit are 2ft. 2in. by 1ft. 7in. by 3ft. high. As shown in Fig. 322 and in the diagram of connections, Fig. 325, there are three valves, a transmitting valve and two rectifying valves. The voltmeter to be seen below the valves indicates the pressure applied to the filaments of the rectifiers, while on the ebonite panel at the bottom of the apparatus there is a voltmeter showing the pressure applied to the filament of the transmitting valve, and a milliammeter which shows the feed current. By means of the transformer ratio switch in the centre of this lower panel and the variable compensating choke, shown in the diagram of connections, the working voltage of the valves can be accurately adjusted in the event of the generator pressure falling below the normal value of 200 volts.

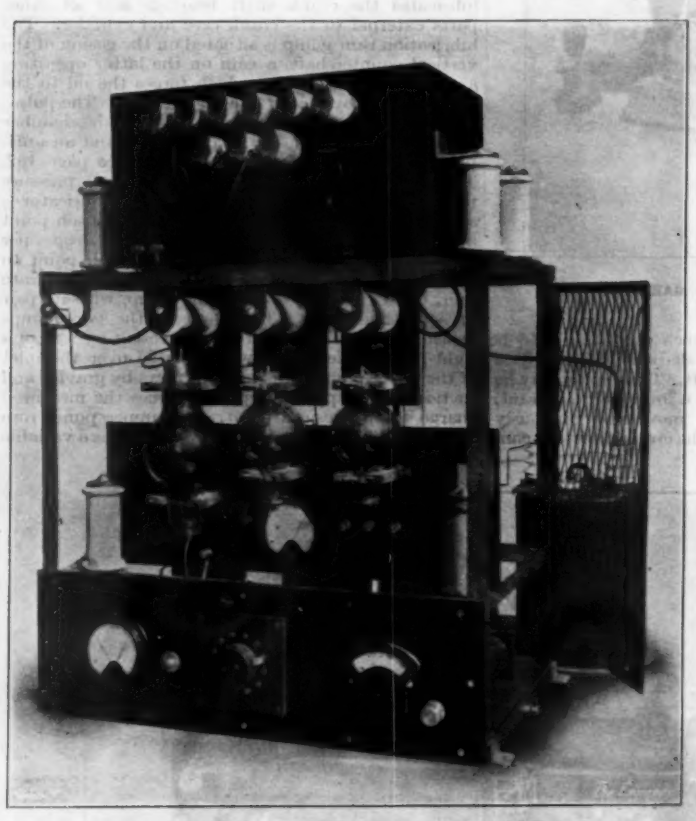


FIG. 322—1½ K.W. CONTINUOUS-WAVE WIRELESS TRANSMITTER—SIEMENS

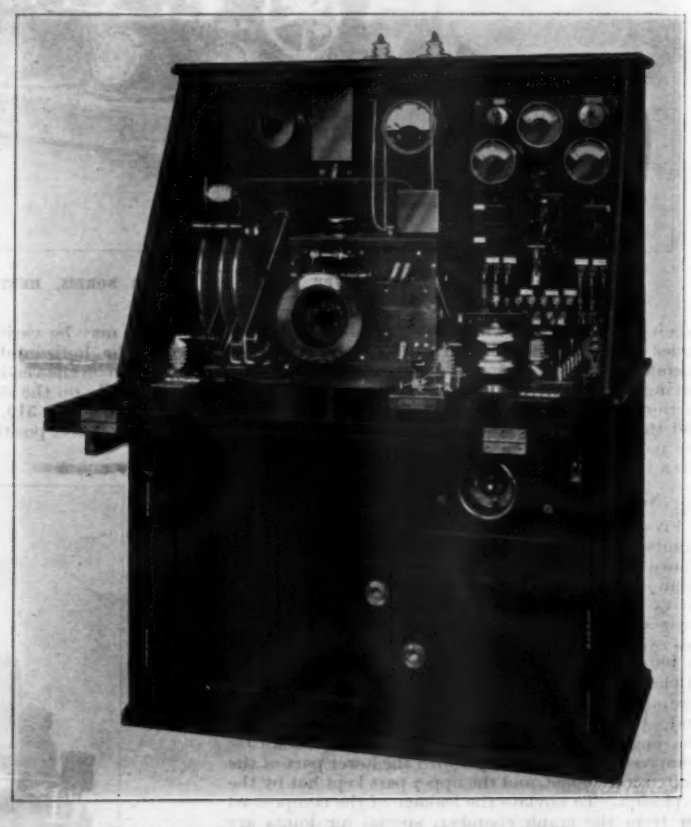


FIG. 323—¼ K.W. WIRELESS CABINET STATION—SIEMENS

The filament transformer smoothing condenser and air core choke are placed on the baseboard of the apparatus, whilst the aerial inductances and reaction coil are mounted at the top, the tappings for varying the wave length being connected to insulators on the face of the inductance case. The grid leak and feed condensers are fixed to the back of the centre ebonite panel. Gauze covers at the sides and at the front of the apparatus serve for screening the valves and high-tension circuits. As will be gathered from Fig. 322, the insulation of the set has received very careful attention.

The ¼-kilowatt spark ship's wireless cabinet, shown in Fig. 323, is another of Siemens' exhibits. The apparatus is operated entirely from a 50-volt battery of accumulators, which is placed outside the wireless cabin, and no separate emergency transmitter is required. The motor generator is placed in the left-hand cupboard, and it is controlled by means of a starter mounted beneath the flap on the right-hand front panel. The sloping part of the cabinet can be folded down to form a desk. On the right of the operator is the switchboard for controlling the motor generator and the charging current. Alterations in wave length are made by adjusting the positions of plugs, which fit into sockets projecting above the table, whilst the power of the apparatus is varied by increasing the number of spark gaps used. At the same time the note is adjusted by a sliding resistance, which serves to regulate the output of the alternator. The receiving gear supplied with each set is suitable for the reception of spark and continuous wave signals up to all the standard commercial wave lengths, the receiver being of the single-valve regenerative type.

Another of Siemens' exhibits is the broadcast receiver shown in Fig. 326. Within the case of this instrument there is a small frame aerial and the instrument is mounted on a turntable to enable interfering stations to be turned out. The set is claimed to give good reception within a 15-mile radius of a broadcasting

station, and when once the set has been tuned, practically no other adjustment is required. The necessary adjustments are easily made, as the requisite settings of the dials for the various broadcasting stations are plainly shown on the instructions supplied with the set. The filament batteries, which are contained in the case, consist of two Siemens dry cells, which, on the assumption that the set is used three hours daily, will last for a period of from three to four months. When exhausted, the cells can easily be replaced at a small cost. Three dull emitter valves are employed—a high-frequency valve, with a tuned anode; a rectifying valve; and a note-magnifying valve, which can be switched on and off as desired. If the set be used with an outdoor aerial, the range is, of course, considerably increased. Transmissions from distant British and continental broadcasting stations can then be received, and the wave length range of the set can be extended by means of plug-in coils. To minimise interference from other stations a complete separate tuning circuit can be supplied, but the set must then be used with an outdoor aerial.

FIG. 326—WIRELESS RECEIVER—SIEMENS

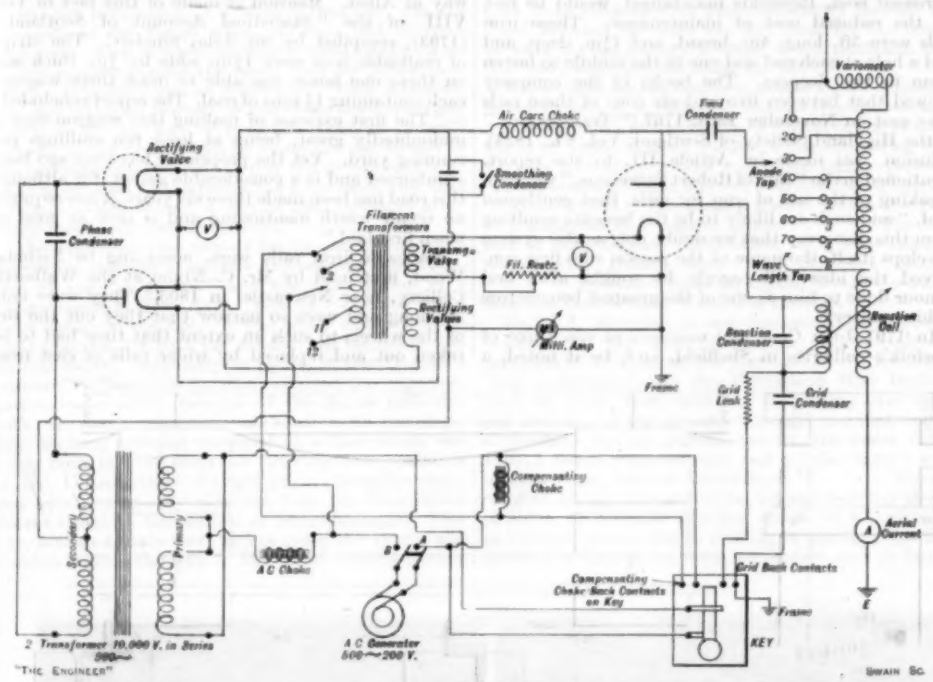



FIG. 325—DIAGRAM OF CONNECTIONS OF SIEMENS' CONTINUOUS-WAVE WIRELESS TRANSMITTER

## The Leafield Wireless Station.

In his address before the Wireless Section of the Institution of Electrical Engineers on November 7th of last year the chairman, Mr. E. H. Shaughnessy, referred to some of the difficulties that had been experienced at the Leafield high-power wireless station and to the methods which had been adopted to overcome them. The Leafield arc station was the first high-power station to be erected in the middle of England, and as soon as it was opened many complaints were received concerning the harmonics and other undesirable emissions of the station. As the staff became more expert in adjusting the flow of methylated spirit into the arc chamber and in adjusting the length of the arc and the field strength, the undesirable emissions were considerably reduced; but it was still felt that every effort should be made to eliminate them altogether. A considerable amount of interesting information on the subject of harmonics and "mush" of the Leafield station is to be found in Mr. Shaughnessy's address, which is published in the *Journal* of the Institution of Electrical Engineers for December, 1923, and those who are interested in the subject should refer to that address.

In order to study the matter and to find a satisfactory method of overcoming the difficulty, tests were carried out in 1921 at the Dollis Hill Experimental Station, which is situated about 62 miles from Leafield, and the tests showed that with coupled-circuit working the harmonics were practically eliminated and the "mush" was reduced to a negligible quantity.

In the Post Office Electrical Engineers' *Journal* of July, 1924, Mr. A. J. Gill describes the coupled circuit that is now in use. With the "plain aerial" scheme which was originally employed the arc burns continuously, and by means of the key inductance the radiated wave is slighted changed, the difference between the marking and spacing vanes being about 0.8 per cent. The arc, Mr. Gill goes on to explain, has many advantages as a transmitter, and practically its sole disadvantage is that the radiated wave contains certain spurious emissions of a shorter wave length than the fundamental. In the case of a well-designed plant the power radiated in these spurious emissions is extraordinarily small in comparison with the fundamental radiation, but these emissions from a high-power station may cause serious interference with adjacent stations receiving on much shorter wave lengths.

The station at Devizes, which works with ships on a 2100 m. continuous wave, was seriously inconvenienced by these emissions from Leafield. After a good deal of work, however, the conclusion was reached that the only satisfactory method of overcoming the trouble was to install a coupled circuit. In a system of this kind the high-frequency oscillations are first generated in a tuned circuit and they are afterwards transferred to the aerial circuit by means of an inductive or other coupling.

An arrangement of this kind is doubly effective in reducing interference. In the first place the growth of spurious oscillations is not encouraged to the same extent in the primary with its concentrated inductance and capacity, as they are in a plain aerial circuit; and secondly, any spurious oscillations generated in a reduced volume in the primary circuit are not readily transferred to the aerial circuit, as the system acts as a filter circuit. Coupled circuits were used in the early days of the Poulsen arc, but owing to the difficulties experienced by their erratic behaviour their use was abandoned in connection with high-power arcs.

In order to gain information on the subject an experimental circuit was tested on the 25-kilowatt arc plant at Stonehaven, and afterwards a commercial circuit was applied to the 40-kilowatt arcs at the Northolt station. As the results obtained were quite satisfactory, a coupled circuit was then designed for the Leafield station.

The chief problem associated with a circuit of this kind is that of constructing the primary condenser, which must have a high dielectric strength, and, if excessive losses are to be avoided, a low power factor. The condenser employed—see Fig. 4, page 160—consists of steel tanks containing aluminium plates which are immersed in oil, the condenser being composed of four units, each having a capacity of 6500 micro-microfarads. The four units are normally connected in parallel, thus giving a total capacity of 26,000 micromicrofarads. The condenser contains 5000 gallons of oil and it weighs 25 tons. Under normal working conditions the condenser may handle 260 ampères at 12,350 m. wave length. The working pressure is thus 68,000 root mean square volts, or a peak pressure of 96,000 volts, and the energy handled is 18,000 kilovolt-ampères. Under these conditions the losses are extremely low. The oil used in the condenser has to be specially treated by means of a centrifugal purifier to eliminate water and foreign matter, and the centrifugal de-hydrator used is shown in Fig. 1.

The primary inductance consists of eight spiral coils of copper strip mounted with their axes vertical, as shown in Fig. 2, page 160. The four lower coils are mounted on a carriage and can be run under the four top coils, which are fixed, so that the arrangement constitutes an effective variometer, the position of the lower coils being controlled by a hand wheel on the operating platform. The coupling between the primary and the secondary or aerial circuit is obtained by means of the variable coupler shown in Fig. 3, page 160. The fixed or outer bank of coils is connected in the aerial circuit, whilst the rotating coils are connected in the arc or primary circuit. The degree of coupling is determined by the angular position of the moving coils, which is controlled by a lever.

With these arrangements the tune of the primary circuit and the degree of coupling can readily be adjusted whilst the arc is working. The whole of the plant required for this coupled circuit, with the exception of the centrifugal de-hydrator, was designed and erected by members of the Post Office Engineering Department. The circuit was put into commercial service on March 16th, and it has been in successful operation ever since. On a wave length of 12,350 m. the power required to maintain a given aerial current is about the same as that needed with the plain aerial circuit as employed at the outset. On the station's shorter wave length, *i.e.*, 8750 m., the power required for the coupled circuit is about 25 per cent. less than that needed for the plain aerial connection.

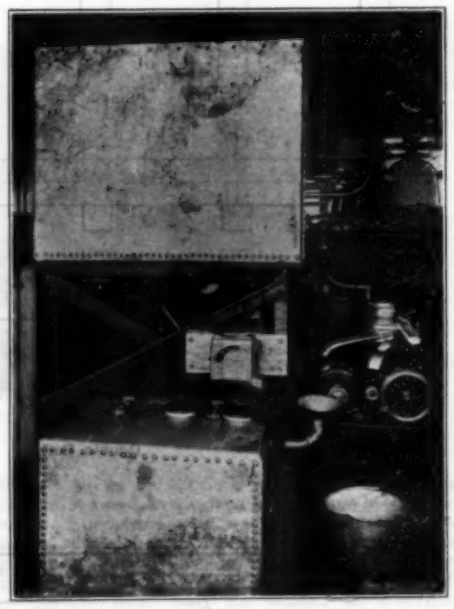


FIG. 1—CENTRIFUGAL OIL DE-HYDRATOR

Keying is done by varying the inductance of the primary circuit, the tune of the secondary or aerial circuit being unaltered. On the marking wave the aerial current exceeds the primary circuit current, whilst on the spacing wave the aerial current is slightly increased.

As a result of the use of this new circuit all interference at Devizes has been eliminated and the signals from Leafield have been improved in respect of sharpness of tune, in constancy and in steadiness.

The success which has attended the operation of this station is indicated by the following paragraph from an article which appeared in *The Times* of March 7th of this year:—"A number of important American newspapers have built their own wireless receiving stations at Halifax, Nova Scotia. The syndicate which uses Halifax includes the leading American newspapers, and two leading news agencies. The news is sent by the British Post Office from its Leafield station. The average number of words transmitted is about 10,000 per day, but the number has reached on occasions 12,000. The London representatives of the syndicate not only send British news, but collect news by cable from Berlin and Paris. The members of the syndicate speak in the highest terms of the efficiency, speed and accuracy of the Leafield

service, and say that the transmission is better than that of any service they have ever received either by cable or wireless. The rate of transmission is about thirty to fifty words per minute."

## One Hundred Years of British Railways.

No. VI.*

### PART I.—THE STOCKTON AND DARLINGTON RAILWAY AND ITS PREDECESSORS.

#### EARLY TRACK.

The track of the wagon-way was one composed of cross sleepers and longitudinal timbers. The sleepers were preferably of oak, 4in. or 5in. square, laid about 2ft. centre to centre apart. The longitudinal rails were usually 6ft. long, 5in. or 6in. in depth, and 4in. or 5in. wide. A rail of this length was therefore carried by three sleepers—Fig. 3. The sleepers were squared for about 12in. from the ends, but not necessarily elsewhere; the rails were squared throughout. The sleepers were of oak from young saplings or strong branches and the rails of fir. At each sleeper the rail and the upper part of the sleeper were carefully bored and a wooden peg was driven through; all joint sleepers had two pegs driven in, one for each sleeper end.

The rails were often of soft wood, which quickly decayed. The best of them, however, were soon worn by traffic and damaged by derailments, and their ends were weakened by the constant boring of fresh holes for the pegs to hold better. Another weakness was that the flange of the wheel did not allow the sleepers to be covered with ballast. In consequence, not only was the road insufficiently held, but the feet of the horses trod directly on the sleepers and wore them quickly away. The remedy for these evils was a second rail, Fig. 4, superimposed on the first. It raised the flange of the wheel and permitted deeper ballasting, and when the upper rail was worn it alone needed replacement, and not, as was often previously the case, the sleepers also. The arrangement just described was known as the "double way" and the earlier as the "single way." The upper rail was of beech or sycamore and of the same breadth as the lower rail, but 3in. to 6in. or so in depth.

Where, as at curves, the rails got badly worn an obvious remedy was the attachment of iron strips. This step was also taken at places where the track was uneven, but in the latter case it was not a success, as the strip yielded to a loaded wagon and the resistance was but little reduced. Moreover, the strips continually became loose and not only was time occupied in replacing them, but the rail was damaged by the holes made by the nails.

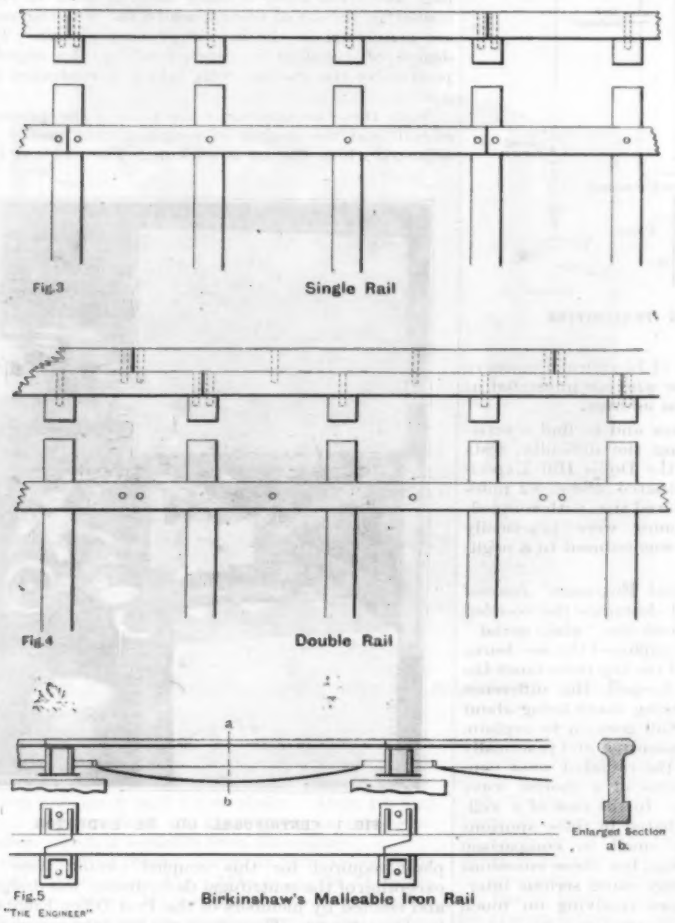
Iron rails had, no doubt, often been thought of, only to be dismissed on the ground of increased cost. Actually, their introduction was somewhat fortuitous About the year 1767 the price of iron was very low and it occurred to William Reynolds, one of the partners in the Coalbrookdale Ironworks, in order to keep the furnaces going, to cast some bars in the shape of rails and put them in the wagon-way. Then, when iron resumed its price, to take them out. The increased cost, Reynolds maintained, would be met by the reduced cost of maintenance. These iron rails were 5ft. long, 4in. broad, and 1¼in. deep, and had a hole at each end and one in the middle to fasten them to the sleepers. The books of the company showed that between five and six tons of these rails were cast on November 13th, 1767 ("Transactions" of the Highland Society of Scotland, Vol. VI., 1824). Allusion was made in Article III. to the report, mentioned in the "Life of Robert Stevenson," wherein, speaking of the use of iron for rails, that gentleman said, "and such are likely to be the benefits resulting from this discovery that we doubt not, as this system develops itself, the name of the person who first conceived the idea will eagerly be sought after and honour done to him as one of the greatest benefactors of his country."

In 1797 John Curr, the manager of the Duke of Norfolk's collieries in Sheffield, and, be it noted, a native of Tanfield in Durham, published his "Coal Viewer and Engine Builder," wherein he spoke of some railroads he introduced twenty-one years previously, *i.e.*, about 1776. From what was said about conveying coal from the workings to the shaft, it is clear that these were underground lines. In fact, he mentioned "wooden rails or waggon-ways underground" and then remarked, "I am of opinion that a great acquisition is still to be made with the same corf (another idea of Curr's) by laying cast-iron roads . . . and placing the corf upon a small frame or tram . . . and hooking or chaining one tram to another." Curr's plates were 6ft. long, 3in. wide, and ¼in. thick. The margin, *i.e.*, flange, was on the inner side and was 2in. deep, ¼in. thick at the bottom, and ⅜in. thick at the top. At each end there was a lug with a countersunk hole, wherewith to fasten the plate to the sleeper. Each plate weighed 47 lb. to 50 lb. The gauge was 2ft. and the sleepers were of oak, 3ft. 4in. long, 4½in. or 5in. wide, and 3½in. thick. The sleepers were recessed for 1in. to receive the plates.

It was said above, that the substitution of rails made of iron for those of wood had, no doubt, often been thought of, but that the idea was abandoned on account of the cost. One who had such thoughts was Richard Lovell Edgeworth, the celebrated Irish road engineer mentioned in Article III. But he was discouraged by the weight of the wagons being greater than the iron rails would carry. The plates broke under the load and not only needed replacing, but the wagon-way was obstructed by derailed wagons. His remedy was, as exhibited to the Royal Society, smaller wagons. He said that several would be as easily drawn as the same load on one wagon. Edgeworth also proposed that there should be iron railways laid on stone sleepers; that there should be special vehicles to carry coaches and chaises and that vehicles on the railway could be moved by stationary steam engines.

Malleable iron rails appeared about the year 1805. Malleable iron had been used twenty years previously for strips on the top of the upper rail of the wagon-way at Alloa. Mention is made of this fact in Vol. VIII. of the "Statistical Account of Scotland" (1793), compiled by Sir John Sinclair. The strips of malleable iron were 1¾in. wide by ¾in. thick and on them one horse was able to draw three wagons, each containing 1½ tons of coal. The report concluded:—"The first expense of making this waggon-way is undoubtedly great, being at least ten shillings per running yard. Yet the proprietor has long ago been reimbursed and is a considerable gainer, for although this road has been made these six years, it has required no repair worth mentioning and is now as good as when first laid."

Malleable iron rails were, according to Nicholas Wood, first used by Mr. C. Nixon at the Walbottle Colliery, near Newcastle, in 1805. They were only 2ft. long and were so narrow that they cut the tire of the wheels to such an extent that they had to be taken out and replaced by wider rails of cast iron.




EXAMPLES OF EARLY RAILWAY RAILS

Subsequent users, experiencing the same evil, made the malleable iron rail wider, but the cost being much increased thereby, a reversion was made to cast iron. Mention must, however, be made of one example of malleable iron rails, as it had some influence with George Stephenson. Robert Stevenson reported that he had been to Lord Carlisle's works in Tindale Fell, Cumberland, and found there malleable iron rails which had been in use for eight years, *i.e.*, since about 1807. There were also two miles of cast iron rail, "but the malleable iron road is found to answer the purpose in every respect better." A copy of this report found its way to George Stephenson, who showed it to Michael Longridge, of the Bedlington Ironworks, and it was, consequently, decided to use malleable iron rails on a wagon-way that had to be built at the ironworks. John Birkinshaw was the principal agent, and he evolved a scheme whereby the breadth and depth were increased without adding to the weight. He patented his design on October 23rd, 1820, No. 4503. Fig. 5 shows the Birkinshaw rail like all the rails of that day, it was fish-bellied. It will be noticed that, unlike the rectangular shape used up to that time, it was given a head and the web was narrowed.

As soon as cast iron was definitely adopted instead of wood for rails the accepted shape was as shown in Fig. 6. It was known as the "plate-way" and was, no doubt, made first by Benjamin Outram at Butterley Ironworks, possibly for the road built for Curr—see above. The plate-way had three great objections:—(1) The wheels of the wagons used to bind against the flange of the rail and set up a degree

* No. V. appeared August 1st, 1924.

of friction which greatly added to the labours of the horses; (2) dust and dirt from the road and wheels accumulated on the base of the rail and also made the haulage heavier; (3) the pins worked out and caused derailments and injury to the horses. It was related in "Inventions, Improvements and Practice of Benjamin Thompson" (1847) that at Fawdon Colliery, in the county of Durham, forty horses were laid aside from this cause (3) within one period of three months.

What, too, must have been an objection, although it was not mentioned by writers of that day, was the presence of the flange when railways had to cross highways. This fact probably accounted for the clause which appeared in all the early Acts for public railways. It usually ran as follows:—"That whenever the said intended railway or tramroad shall cross any public or private way or road the plates of the said railway or tramroad shall be made for the wheels of the carriages used thereon to run in a groove and from the highest part of the plates the sides each way shall be made aslant in such a way as that carriages of all kinds may easily pass over them."

The objection just named led to one of the most important changes in railway engineering—the adoption of the "edge-rail" and the substitution of a flange—spelt in those days "flanche"—on the wheel for a flange on the rail. It was really a return to an early practice, for with the wooden rail the flange was on the wheel. Singularly to relate, it was Outram's partner, William Jessop, who invented the edge rail, and it came about because of the flange difficulty with Outram's plate-way at road level crossings. The deciding incident occurred on a line which was being built in 1785 from the Leicestershire coalfields to the Leicestershire Navigation at Loughborough, and which eventually only ran from the Charnwood Forest Canal at Nanpanton to Loughborough. This line, laid as a plate-way, had to cross the Derby and London main highway. The road commissioners refused to allow the flanged rail to be used and Jessop then suggested that the wheels should be flanged instead of the rail. He proposed that on the outside of the wheel a "guiding wheel" should be attached and that it should run in a groove $\frac{3}{4}$in. wide and $\frac{3}{4}$in. deep. The groove was, however, abandoned and the rail took the shape shown in Fig. 7.

According to Benjamin Thompson, one of the first uses of the "edge rolly rail" was made at Ouston Colliery in 1816. As there is no record of any earlier use after their introduction by Jessop in 1789, it would seem that Outram's plate-ways, where wooden rails were not used, must have been firmly established. It has, however, to be remembered that the adoption of the "edge rail" necessitated the provision of a flange on the wheel. Thompson proceeded to say that on the introduction of the edge rail at Ouston a quarter of the horses previously employed were dispensed with, although the same amount of work was done. John Buddle, of Wallsend, was said by Thompson to have declared that, by one means or another, it saved one-third of the horses.

The edge rails had at first a lug cast at each end like that on Curr's rail, except that the opposing ends were different, in order that the lug on one rail could scarf with that of its neighbour and one nail fastened the adjoining ends to the same sleeper. But these lugs broke off and the chair was then introduced to carry the two ends. William Losh, of Losh, Wilson and Bell, of the Walker Ironworks, and George Stephenson, for instance, obtained patent No. 4067 of September 30th, 1816, for a form of rail and chair—Fig. 8. Among other features the ends of the rails were bevelled for about 2$\frac{1}{2}$in. and one pin was driven through both sides of the chair and both the bevelled ends. The rails continued to be made of cast iron and to be about 3ft. 6in. in length.

It was observed by Nicholas Wood in 'A Practical Treatiss on Rail-roads" (third edition, 1838) that "This plan of joining the rails was evidently a great improvement upon the common mode and was therefore adopted on several new lines of road. The blows and shocks to which the carriage wheels were exposed in the old plan of joining were almost entirely eliminated in this, and the benefit was not confined to the carriages alone, for the reaction of those shocks was liable to break the rails in return." The use of the edge rail caused the lines on which it was employed to be called "railways," in contrast to "tramways" where plate-ways were used.

It is difficult to say why stone blocks were chosen as supports for the rails in preference to wooden sleepers. A cause which has been suggested is that the colliers, angry because the rails reduced the number of horses and horsemen employed, burnt the wooden sleepers. But that could at most have only been a passing phase, and it is more probable that stone sleepers were preferred partly because the space between the rails was left clear for the horses to walk in, but mainly because of the mistaken idea that the more rigid the track the better.

It should be known that iron sleepers were employed before stone, *e.g.*, at Sirhowy. George Overton wrote in "A Description of the Faults or Dykes of the Mineral Basin of South Wales" (1825), when comparing iron sleepers with stone blocks:—"From long experience n the use of both I much prefer iron dovetailed sleepers to stone blocks. The former always retain the rails or tramplates to a regular gauge. . . . The first cost of iron sleepers, particularly for a wide road, is considerable greater than that of stone blocks. . . . In roads I make for myself, where the width does not exceed 3$\frac{1}{2}$ft., I use iron sleepers."

Mr. W. L. Meredith, at one time one of the divisional engineers of the Midland Railway, delivering the presidential address at the Institution of Permanent Way Inspectors—now the Permanent Way Institution—in June, 1885, said:—"In looking over some old accounts of the construction and maintenance of a tramway by my grandfather, in the years 1807–1821, I found what we may call a 'platelayer' was, in those years, called a 'block-layer.' . . . The art of block-laying consisted of laying and bedding blocks of stone, of irregular size and shape, to a horizontal or inclined plane, and in drilling or boring holes and dressing a surface on them to receive and to fasten to them the cast-iron plates of the tramway. The tram-plates laid on these stones could not be laid roughly on the formation, after the manner of our present permanent roads, but had to be laid to a line after the manner of building walls and bridges in masonry and bricklaying."

The stone blocks were never less than 2ft. square and 1ft. thick. They were generally laid diagonally, as this gave the workmen more ready access to them if they needed adjustment than if laid at right angles to the line. Holes were drilled into the stone, into which oaken plugs were driven. The chair was placed on the stone and fastened by two iron pins driven into the plugs, which had previously been bored with a $\frac{3}{4}$in. auger.

Details of the track, such as keys, switches, crossings, check rails, &c., will be noted in a subsequent article.

FIG. 1

FIG. 2

FIG. 3

## Shingle Beaches and the Wear of Concrete.

By Dr. JOHN S. OWENS, Assoc. M. Inst. C.E.

All engineers who have had to do with concrete structures erected on the foreshore and exposed to the grinding action of shingle or boulders are aware of the destructive effect upon the surface of the concrete. It is impossible entirely to prevent the wearing away of concrete surfaces, or indeed any other surface, unless it be completely protected from the abrasive action of the stones and shingle hurled against it by the waves. In the present article is described a method which has been used successfully on the South Coast, and the aim of which has been to provide for the concrete a surface that:—

(*a*) Would resist the abrasive action of the shingle as much as possible consistent with limitations as to cost; and

(*b*) Would permit of easy renewal when worn.

It may be well as a preliminary to consider the detail mechanism of attrition:—When a stone is driven against a concrete surface with sufficient velocity it is practically certain that some part of that surface will be broken down into fragments, which are immediately washed away by the waves, exposing fresh surfaces. The action may be very small and localised, but nevertheless if it goes on continuously it soon produces an effect easily observable. It is evident that when such a stone strikes a concrete surface the surface must give way if the stress at any point exceeds the crushing strength of the material; the actual stress will depend upon such factors as the weight of the stone, its velocity and shape. The stone at the moment of striking possesses a certain amount of energy given by the expression $\frac{W V^2}{2g}$. If there be an elastic deformation of the surface so that it is compressed through a distance of $x$ in bringing the stone to rest the pressure exerted by the stone upon the surface will be equal to $\frac{W V^2}{g x}$; that is, the total pressure varies inversely as the degree of compression.

If, however, we substitute for the hard resisting wall some material which will act as a buffer with a certain amount of elasticity and will reduce the velocity of the stone more gradually, the force due to the blow will be reduced accordingly.

The author has attempted to bring about this result by various methods; for example, applying to the surface of sea walls a coating of a mixture of tar and pitch. This plan was not successful, as owing to the walls being always damp, the material would not adhere sufficiently, and further, it was found that each particle of shingle or stone which struck the surface carried away a little of the coating on itself, with the result that it soon disappeared.

The next method tried was facing the walls with asphalt blocks, and that was not successful either. It was found that the blocks were costly to apply and difficult to fix in position, while the rate of wear was not reduced so much as might have been anticipated. Furthermore, in warm weather the surface showed a tendency to blister, as it was not attached to the concrete all over. As the purpose of this article is to describe a method which was found successful no further time need be wasted in describing unsuccessful attempts to solve the problem.

In work carried out by the author on the Sussex Coast for the East Sussex County Council, it was observed that pieces of timber with the end grain exposed, when left in the face of concrete sea walls, very soon projected beyond the face if there was any attrition going on. Evidently the timber resisted the attrition better than the concrete. An experiment was, therefore, made in which a patch of a few square yards of sea wall was faced with wood blocks set in cement, with the end grain exposed. These blocks were some of them of elm and some of larch; and, to remove the danger of cracking the concrete from expansion of the blocks when wetted, the latter were soaked in water for 24 hours before being set in position in the wall. Fig. 1 shows a patch of such blocks put in in 1921.

Surrounding the blocks is a facing composed of large flint boulders set in cement mortar 2 to 1. The blocks and the flint facing were put in at the same time and originally formed part of the same surface. It can be seen from the engraving that the flint boulders and the concrete are worn back more than are the wood blocks. The actual amount of wear is from 1$\frac{1}{2}$in. to 2in. more in the former than in the latter. The photograph from which the engraving was made was taken on June 25th last, that is to say, when the blocks had been in position for some three years. The piece of wood laid on the middle of the patch of blocks was placed there to make more evident the extent of the wear of the flint faced surface above the blocks. Where the shadow of the piece of wood falls the amount of the wear above the wood block facing is quite evident. The wood blocks themselves show very little indication of wear, except at the corners where exposed by the wearing back of the flint facing. It was further noticed that where a knot came to the surface of the wood there was a definite hollow worn, the

hard knot being worn more rapidly than the surrounding soft wood.

There was no trouble from cracking of the concrete or expansion of the blocks, and indeed it was not to be expected that there would be considering (*a*) that the blocks were soaked for 24 hours before laying; (*b*) that they are wetted twice in 24 hours by the sea; and (*c*) that such wetting was by salt water, which does not promote rapid drying.

Other similar patches of wood blocks were tried elsewhere with the same result, and the experiments were regarded as being so promising that a considerable length of sea wall was faced this spring with wood blocks. The blocks in most cases were 6in. square on the surface, the end grain being on the face. They were set with headers 9in. long at intervals, the other blocks being 6in. deep. All the blocks were set in neat cement grout and were held in position in the first instance by double-pointed nails, as one of the difficulties encountered was to keep them in correct position while the concrete behind was filled in and rammed. In Fig. 2 the wood block facing is shown; the clerk of works is seen pointing towards the junction between the wood blocks and the concrete facing above the attrition level. In Fig. 3 the general appearance of the wall can be observed.

In connection with the wear of concrete surfaces, the author has found that a small amount of coarse shingle or boulders lying along the front of a wall is about the worst condition for bringing about abrasion of the face. In the case referred to, the foreshore is chalk save where it is covered with flint shingle or boulders, and when the quantity of such boulders or flints is small it acts as a powerful abrasive upon the chalk shore as well as on the wall faces. When the quantity increases sufficiently to protect the shore itself, that part of the trouble is over, but should the level at the junction of the wall remain constant for any length of time the wall face is sure to suffer. There appear to be several means of preventing this abrasion of the surface; for example, if accumulation of shingle can be encouraged so that the level at the wall surface gradually rises it will shift what we may call the cutting edge to new levels on the wall, and will not concentrate all at one level. Again, the substitution of fine shingle for coarse boulders will tend to remedy the trouble, and that is being done at present in conjunction with the wood block facing illustrated in Figs. 2 and 3. The fine shingle is dumped from barges in front of the wall and between groynes, which direct it up the foreshore. Such dumping is necessary in this case on account of the small amount of beach material available, and the consequent slow rate of accumulation. Such fine shingle when dumped between suitable groynes is held and acts as a comparatively permanent protection for the face of the sea wall.

The flints forming the natural beach vary in size up to 5in. or 6in. in diameter and when, as sometimes happens, there is a grading by which all the large flints are collected together in one place, the destructive effect of a rough sea can be well imagined.

## SIXTY YEARS AGO.

In our issue of August 5th, 1864, we reprinted a paper, of some historic note, on a uniform system of screw threads, read by Mr. William Sellers, of Philadelphia, before the Franklin Institute. Having examined the "English" thread standards, he expressed the opinion that while the relationship between the pitches and diameters might be improved—particularly in the case of ¼in. screws, the twelve threads per inch of which were held to be too coarse—any improvement possible would not be sufficiently great to justify a new standard by itself. The "English" thread form was, however, held to be open to criticism on the grounds that it was difficult to make and to check for accuracy. He then proceeded to propose his system of 60 deg. thread with a flat top and a flat bottom, the form now in use in the United States. In spite, however, of Mr. Sellers' remarks about pitches, the American standard to-day does differ slightly from the Whitworth, principally in the larger diameters. The paper and the discussion on it revealed that at that date there was considerable disparity in the practice of American engineers in the matter of thread and nut sizes, whereas in this country the Whitworth system was already well established. . . . In the course of a leading article, entitled "The New Joint Stock Companies," it was remarked that the new class of undertakings which had been formed under the Limited Liability Act were looked upon by many with mistrust. In its application to the engineering industry, however, we welcomed the Act. It was pointed out that the early engineers were gravely hampered by lack of capital, and that the development of the industry had been retarded until such time as by their own efforts they had accumulated sufficient capital to extend their operations. There was at the time of writing vast scope for the enlargement of the engineering industry for "what were once the curiosities of infant arts are now the necessities of all civilised, and even partly civilised, nations." We also welcomed the new companies on the ground that they would tend to diminish the rates of profits. "Those who know anything of the history of the great private engineering firms," we wrote, "know that their profits have been enormous profits, which, however we may congratulate the recipients upon their good fortune, it is not fair that the commerce of the country should continue to pay." . . . In another leading article we dealt with the drilling *versus* the punching of plates, a subject which had provoked a lively discussion at the summer meeting of the Institution of Mechanical Engineers at Glasgow. Punching for rivet holes was, we wrote, a barbarous mode of making a hole in an iron plate, and, in spite of the late Richard Roberts' ingenious Jacquard punching machine, which had been successfully employed on the plates for the Conway, the Victoria, the Boyne and some other bridges, it ought to be abandoned to a great extent, if not altogether. Mr. Adamson, the eminent boilermaker, of Hyde, reported, we remarked, that he found drilled plates stronger and tighter in the joints than punched plates, and that within a year or so every boiler plate worked up in his factory would be drilled. Mr. Adamson, it seems, added that he had still greater confidence in welded seams, a practice which we designated a grand improvement which had occasionally been resorted to by Bury, Hackworth and others, and which, it might be concluded, would eventually come into general use in the case of boilers made of plate iron.

## "Willing Worker" Circular Saw Bench.

There has recently been introduced by Drummond Bros., Limited of Guildford, a light circular saw bench, which the makers claim to be very economical in the use of power. There are two main reasons for this economy—first, the spindle runs in ball bearings, by which friction is reduced to a minimum; and, secondly, the binding action of the work is prevented when cross cutting by the use of a sliding carriage which is shown in the illustration. This consists of a platform which is carried on two steel guides running on the main table. The platform is divided to allow it to pass the saw, and carries at its front edge four vertical steel rods, against which the work may be thrust with perfect safety when sawing. The centre two rods carry the guard and dust catcher. This latter prevents the saw dust from flying into the operator's face. No matter what shape the log may present, it can be conveniently and safely handled on the slide, the operator's hand being well away from the saw while the

THE "WILLING-WORKER CIRCULAR SAW BENCH

work slides bodily forward without shifting. A stop is provided which limits the travel of the sliding guard. This stop may be slipped out of position when the slide is not in use. The whole slide may be instantly removed from the machine by lifting it vertically, when the table is free for use as a plain machine, and the side fence may be swung up into place as usual. The saw spindle itself revolves in two large size ball bearings, carried in one solidly cast housing. This fact insures that the two bearings are always in perfect alignment, and the spindle, therefore, runs with absolute truth. The lubrication of the spindle is provided for by means of two large grease lubricators. The machine is made with either 20in. or 24in. saws, and the makers claim that a 3 brake horse-power engine or motor is powerful enough to operate it.

## THE SCAPA FLOW SALVAGE OPERATIONS.

In a Journal note which appeared in our issue of July 11th we gave a brief description of the preliminary operations connected with the salving of the torpedo-boat destroyer V 70. This vessel is the first unit of the scuttled German fleet at Scapa Flow, upon which operations have been begun. We now learn from Cox and Danks, Limited, that V 70 has been successfully raised and beached in Mill Bay. It will be remembered that the method employed in the salvage operations, which, during the present year are expected to embrace some 24 torpedo-boat destroyers, consists of employing two floating pontoons formed from the original floating dock used by the German Navy for testing submarines. This dock was prepared at Cox and Danks' shipbuilding yard at Queenborough, and was towed to site and then cut into two halves transversely so as to form two lifting pontoons, each approaching 200ft. in length. Each pontoon is furnished with ten 10-ton triple-geared hand-operated lifting winches, each with a 100-ton block and tackle attached to it. The hauling ropes from the tackles are carried over a series of pulleys which are mounted on a common shaft that runs along the edge of the pontoon. The first full scale experiment in the lifting of V 70 was carried out on the morning of Sunday, July 6th, when the ship was raised about 7ft. clear of the bottom by means of chains and wire ropes passed under the hull and attached on each side to the lifting gear. It had been hoped that the stout link chains supporting the weight of the ship would withstand the stress, but the breaking of one chain was quickly followed by others, till the vessel was only supported by the wire ropes, and was again lowered to the bottom of the sea. This experiment fully demonstrated the success of the salving method employed, and during the interval the chain slings were replaced by wire ropes having a circumference of 9in. The next attempt was made about four o'clock on the morning of Friday last, when a calm sea prevailed with a dead low tide. Under these favourable conditions the hauling ropes on the twenty winches were made tight gradually, and with the assistance of the tide the ship was drawn up until the deck of the destroyer was only about 2ft. below water. The complete operation was carried out, we learn, very smoothly, and not a hammer or spanner was needed during the whole of the raising operation, performed only by the turning of the winch handles. When in the raised position all the floating structure comprising the destroyer hull and the attached pontoons was towed to Mill Bay, where the destroyer was grounded on a sandbank. This was done at about 11 a.m. on Saturday morning, so that the whole of the lifting and beaching operation was carried out in a little over 7 hours. Subsequent examination of the destroyer showed that, although she was covered with seaweed, comparatively little rusting had taken place. Messrs. Cox and Danks are to be complimented on the success of their carefully prepared salvage scheme which, it is expected, will result in the raising of the majority of the sunken torpedo destroyers at Scapa before the end of the year. Attention is now being paid, we understand, to the more difficult task of raising the battleship Hindenburg, which is to be attempted next year.

It is a noteworthy coincidence that the raising of the first unit of the scuttled German Fleet should have been accomplished almost exactly ten years after the declaration of war.

## STRANDING OF THE CROSS-CHANNEL STEAMER NEWHAVEN.

The Southern Railway Company's cross-Channel steamer Newhaven went ashore off Berneval, about four miles east of Dieppe, while making her usual night run from Newhaven to Dieppe, on Monday night last. The Newhaven is a vessel of 1656 gross tons, propelled by triple-screw turbines of 10,000 indicated horse-power, designed for a speed of 20¼ knots, and was built at Havre in 1911. She is manned by a French crew under Captain Rondeau, who is reputed in the service for his careful and skilful seamanship. The vessel left Newhaven at the scheduled hour with 146 passengers and a crew of 60, and the French coast was reached in a very heavy fog about two o'clock on the morning of Tuesday. Usual precautions were, we learn, taken and the speed of the ship was slowed down, but at 2.10 the ship grounded and was driven hard upon a soft sand and chalk bank beneath the cliffs. Wireless signals for help were immediately sent out and were received by the Dieppe, another of the Southern Railway Company's steamers, which had left Dieppe for Newhaven. The Dieppe started to make for the stranded vessel, but received a wireless message from the Newhaven that no help was required.

The shock of impact inflicted slight injuries to two lady passengers and three of the crew of the Newhaven, but otherwise no harm resulted from the grounding, and the passengers were disembarked in boats at 7 a.m. in the morning and taken to Dieppe by motor transport. A special train left for Paris at 9.15 with 137 passengers and baggage, arriving only five hours late. At the time of writing the Newhaven remains hard and fast, lying in an almost broadside position near the cliffs. Several efforts have been made to refloat her, and assistance has been requisitioned from Dieppe and Havre. Among the first ships to arrive at the scene of the accident was the French tug Duquesne and the lighters Yvonne, Gaston and Barbue, which assisted in disembarking the passengers and baggage. Later on the Abeille from Havre was pressed into service and also the salvage boat Le Sauveur. As all efforts at refloating the ship have so far failed, it is not very hopeful that the Newhaven will be floated until the next spring tide, which is ten days hence. Meanwhile every effort to save the ship is being made, both by the French and British railway authorities.

## CONFERENCE ON THE GENERATION AND DISTRIBUTION OF ELECTRICAL ENERGY.

We are asked to state that a commencement has been made with the organisation of the third session of the Conférence Internationale des Grands Réseaux Electriques à Très Haute Tension, which is to be held in Paris towards the end of June next year.

The first session of the Conference took place in 1921, and was attended by 51 delegates representing 12 different countries. The second session was held in 1923, when the delegates, which came from 20 different countries, numbered 150. The 1925 session is to last eight days. It has for its object the study of all the problems attaching to the following matters:—(*a*) The production of electrical energy in large heat or hydraulic power stations; (*b*) the interconnection of these large power stations; (*c*) the construction of long high-tension transmission lines; (*d*) and the working of transmission and distribution networks.

The discussions will be carried on either in French or English, and they will be based upon reports sent in by members of the Conference. Forty-five such reports were sent in for the 1921 session and forty-nine for that of 1923. Advantage will be taken of the meeting—as was done on the two former occasions—of visiting a selection of industrial undertakings in France.

The detailed programme, as well as an explanatory notice and other information, are obtainable on request, from Monsieur J. Tribot Laspière, Secrétaire Général de Conférence Internationale des Grands Réseaux Electriques, 25, Boulevard Malesherbes, Paris.

On Monday, August 18th, the London Underground Company will open for traffic the new extension of the Hampstead and Highgate Railway, from Hendon to Edgware. This latest extension, which comprises three stations, is, perhaps, the most important new work completed by "The Underground" since the war, providing, as it does, a much needed connection between London and Edgware, Burnt Oak, and Colindale.

## Railway Matters.

IT is with much regret that we have to announce the death on the 1st inst. of Brigadier-General Sir Hugh Drummond, Bart., the chairman of the Southern Railway. Sir Hugh was the chairman of the London and South-Western Railway until it became a constituent member of the Southern Railway. He had only been a director for four years when he was made the deputy chairman, and when, seven years later, Sir Charles Scotter died, Sir Hugh succeeded him as chairman.

SIR RALPH WEDGWOOD, the chief general manager of the London and North-Eastern Railway, has issued an appeal to the enginemen on the 7000 miles of railway under his control, which reads as follows:—"Coal costs 22s. per ton. We use 4½ million tons a year. Our coal bill is thus £4,675,000. If every locomotive burnt 1 lb. of coal less for every mile it ran the company would use 75,000 tons less in a year and save £80,000. Will every engineman help his running superintendent to get this economy?"

THE London and North-Eastern Railway has declared an interim dividend at the same rate as a year ago, but to do so it has been necessary for it to draw on the reserves, which it did not have to do last year, though it had to be done last January. The explanation given for this step is the continued trade depression among the staple industries on the East Coast. To this we would offer the further suggestion that the London and North-Eastern has in its group a greater number of weaker companies than have its neighbours, and for some time they will be a strain on the finances.

THE London, Midland and Scottish Railway Company has imitated the excellent example of the Great Western in preparing a "Safety First" pamphlet. This is entitled "Prevention is better than cure," and contains "A few words of advice regarding the cause and prevention of accidents, dedicated by the London, Midland and Scottish Railway Company to each member of the staff directly or indirectly engaged in the movement of traffic." The booklet consists of fifty-four pages and gives advice not only by letterpress, but, better still, by picture, to all grades of men—shunters, porters, horse loaders, users of cranes, draymen, enginemen, signal fitters, platelayers, loaders, &c.

THE position of Commissioner to the Government Railways of Tasmania, to which reference was made herein on February 22nd and April 25th last, has been filled by the appointment of Mr. Charles Miscamble, one of the Commissioners of the Victorian Government Railways. The Tasmanian Railways are to be congratulated, inasmuch as Mr. Miscamble is a practical railwayman, having been on the Victorian Railways for thirty-six years until he was made a Commissioner five years ago. It is pleasant, too, to reflect that, unlike the two previous similar appointments—Victoria and South Australia—made by Australian states, the selection has not been made from the United States.

THE line between Invergarry and Fort Augustus, London and North-Eastern Railway, was obstructed on the afternoon of August 2nd by about 100 tons of rock and earth being swept on to it as a consequence of a cloudburst. A passenger train ran into the obstruction, but beyond the derailment of the engine there was no personal or material damage. The line was cleared by Sunday morning. The accident was thus a very minor one when compared with what happened at Spean Bridge on the Aviemore-Inverness line on June 18th, 1914, when a cloudburst flooded the Baddengorm Burn so that a bridge was washed away whilst a passenger train was passing over it. Five passengers were drowned on that occasion.

THE signalman at St. Helens has an imperfect view of the bay line there, and so, when any train occupies that road, the platform staff turn a switch which locks the home signal for entering the bay. On March 19th last a shunter was anxious to get away to attend to another train, and as soon as he had given the signal for a train to leave the bay he reversed the switch without waiting until the train had left. Unfortunately, the signalman overlooked the latter train, and when a second train had to enter the bay he lowered the signal—which was improperly free—and a collision resulted. Major Hall inquired into the accident and recommends that the permissive lock of the switch be replaced by the definite lock of a track circuit.

THE programme of the Canadian National Railways for the construction of 26 branch lines and extensions can only be partially carried into effect. It was embodied in 26 Bills which were adopted by the House of Commons, but seven of the number were thrown out by the Senate. These seven lines were principally laid out to open up new territory in Saskatchewan, and represent a length of 378 miles out of a total mileage embraced in this year's programme of 965 miles. The estimated cost of the rejected lines is a little over 12,000,000 dollars, out of a total estimated cost for the whole programme of slightly over 28,000,000 dollars. These Bills were regarded as essential to the plans of Sir Henry Thornton for placing the Canadian National Railway system on a paying basis, and the action of the Senate is attributed to the influence of interests opposed to the principle of public ownership, and has aroused a strong feeling of resentment in Western Canada.

IN this column of our issue of February 29th mention was made of the misfortunes of the Ballycastle Railway. It is a narrow-gauge line, 16¼ miles long, opened in 1880, and runs from Ballymoney, on the Northern Counties section, to the harbour of Ballycastle. For some time it has been unable to pay its way, and because the Ministry of Transport has now nothing to do with the railways of Ireland—either in the northern area or in the Free State—it could not assist it. Nor could the Northern Parliament offer any help. The shareholders therefore met and agreed that the property should be disposed of as the directors should think fit. It is now announced that the London, Midland and Scottish—the owners of the Northern Counties system—will take over the line. This is the best thing that could happen to the Ballycastle undertaking, as its line readily can be made part of the larger system, and, moreover, the Northern Counties has 42 miles of narrow-gauge between Larne and Parkmore in the same county of Antrim.

## Notes and Memoranda.

ACCORDING to the *Electrical Review*, Mr. W. Brooks Sayers, pursuing the development of his "inductor cylinder dynamo," in which the free armature core remains stationary whilst the winding rotates, now has two six-pole machines with a nominal rating of 25 kilowatts each, in running order, and is about to put them through efficiency tests, &c.

A VERY effective wireless installation is being fitted on the new Zeppelin which has recently been constructed for America. The apparatus, states the *Wireless World and Radio Review*, has a telegraph radius of over 1500 miles, while telephonic communication is possible over 300 miles. The antennæ are fan-shaped, and the three suspension wires have a length of 400ft. Power is derived from a 1½-kilowatt generator driven by a screw propeller.

EXPERIMENTS carried out at a short distance from a broadcasting station with a crystal set from which the crystal had been removed show that reception is possible if portions of the human body are substituted for the crystal, one contact being firmly made and the other being very slight. The conclusion is reached that the effect is an electrolytic one, as a solution of salt water, having approximately the same resistance as the body, gives similar results.

THE ease with which alternating current can be transformed, states the *Electrical World*, leads in many cases to too free a use of transformer equipment and consequent losses in energy and lowering of service standards. It is all too common an experience to find banks of substation transformers through which the voltage is stepped down to a low value and then up again to serve a group of customers at such a distance that the lower voltage cannot be used. The result is a constant loss in energy that mounts into a startling number of kilowatt-hours annually. Regulation and service are not improved by such an arrangement, and extra hazards are produced from multiplying the apparatus.

CONTRACTS for the construction of the largest electrically propelled sea-going passenger liner have recently been given the Cramp Shipbuilding Company by the American-Hawaiian Steamship Company, Incorporated. The turbine electric drive was selected in preference to a direct Diesel engine drive or a geared turbine. The turbine-electric propulsion equipment, consisting of two Curtis turbines, with a total of 20,000 horse-power, will be supplied from water-tube boilers burning oil. The turbines will drive two alternating-current generators, each having a capacity of 7700 kilowatts, which will drive two synchronous motors of 10,000 horse-power, direct connected to the propeller shafts. Accommodation will be provided for 600 first-class passengers and 250 members of the crew.

THE pulp and paper industry has proved itself to be one of the most remarkable industrial developments of the Province of Quebec. From a small beginning it has developed in thirty-five years to be one of the biggest industrial factors of that country. The first paper mill was established at St. Andrews in 1803, at a time when only rag paper was made; but about the middle of the eighteenth century the process of making paper out of wood pulp was instituted. This presented a new era for the development of the forest wealth. Since that time tremendous steps of progress have been made, and to-day pulp-making occupies a very considerable part in the life of the province, both from the standpoint of the capital invested and the number of workers engaged in it. Of the 104 pulp and paper plants in Canada, 54 of them are situated within the limits of the Province of Quebec. In 1922 these represented a capital value of 191,514,809 dollars.

THE Dominion Water Power and Reclamation Service of the Department of the Interior of Canada has recently prepared an analysis of the use of water power in the pulp and paper industry in Canada. The importance of this industry to the national life of Canada is well known. The capital invested in it amounts to over 380 million dollars, and the exports of pulp and paper products during 1922 were valued at 123 million dollars, being exceeded in value only by the group of agricultural products. As cheap power is an essential factor in this industry, it is not surprising that 90 per cent. of the power used for that purpose in Canada is derived from waterfalls. The bulletin above referred to gives a general discussion on the present use of power in the pulp and paper industry, construction activities, and future power requirements, with tables showing the mills now being operated by water power arranged by provinces, with details of their power installations and other tabular information.

A RECENT issue of *Nature* refers to a paper by Fraülein Angelika Székely, which describes experiments in which the characteristic curves for current and voltage were determined for loosely touching steel spheres. As found by previous experimenters, the voltage increases at first slowly and regularly with the current, until a critical point is reached, when the voltage drops to a considerably smaller value than before. This value remains constant when the current is increased further, and is known as the equilibrium voltage. With pressures of from 1 to 20 grammes, using spheres with radii from 0.5 cm. upwards, its value was 0.22 volts, and was the same with a sphere and a plate of steel. With alternating currents this value corresponds to the maximum instantaneous value of the observed effective equilibrium voltage. For currents smaller than the greatest which has passed through the undisturbed coherer since the establishment of equilibrium voltage, it behaves like an ordinary constant ohmic resistance, which diminishes as the maximum current through the coherer increases. The observations agree with the old theory of the formation of metallic bridges between the spheres at the critical voltage, the sectional area of the bridges increasing with the current, so that the product, current by resistance, remains constant. By drawing the spheres slightly apart while current was flowing, the existence of metallic bridges was demonstrated microscopically, and they were photographed. Nickel was found to behave something like iron and steel, while with copper, zinc and brass no visible bridges were formed.

## Miscellanea.

ACCORDING to the *Wireless World and Radio Review* preliminary tests from the new broadcasting station at Johannesburg have been heard in all parts of the Union and also in Bulawayo. It is interesting to note that the announcements from the station are made in two languages, English and Dutch.

CONVERSION to automatic working of the whole Durban telephone system, in sections of 2000 telephones a year, over a period of four years, has been approved by the Durban Town Council. The cost is estimated at £40,000 per annum. Durban is the only town in the Union in which the telephone system is owned and operated by the municipality.

THE turbo-condensing locomotive invented by the Swedish engineer, M. Ljungstroem, has made a record journey, travelling the whole distance between Gothenburg and Stockholm—about 280 miles—without renewing its coal supply, and consuming only a comparatively small quantity of water compared with ordinary locomotives on the same journey.

IMPROVEMENTS to cost 1,000,000 dollars are planned in the Bethlehem Shipbuilding Company's yards on Terminal Island, Los Angeles Harbour. This money is, we learn, to be spent in changing the berthing arrangements, so that six vessels can be docked for repairs at one time. The shops will be moved closer to the berths in order that the work may be speeded up.

THE 8000-ton tanker Allentown, purchased from the United States Shipping Board by the Atlantic Refining Company, is to be converted from steam to Diesel-electric propulsion. The Allentown will be the first tanker to have this form of propulsion. Contracts have been placed with the Westinghouse Company for the electrical equipment, and with the Ingersoll-Rand Company for a Diesel engine of 2300 shaft horse-power.

A TOTAL of 500,000 dollars, an amount sufficient to allow all the work that could be carried out this year to be accomplished, has been voted to the Quebec Harbour Commissioners by the Federal Government. The contemplated improvements to the harbour involve an expenditure of 10,000,000 dollars, and it is understood the Federal Government has agreed to the proposed plans, but stipulates that the loan is to be spread over a number of years.

IT is announced that the Belgian metallurgical concern known as the Société Ougrée-Marihaye has secured the Belgian, Luxemburg, German, Swiss and Belgian Congo rights in the Quigley process for the utilisation of pulverised fuel for the firing of steam boilers and steel furnaces. The company has for some time had a 30-ton per hour pulverising plant in operation at Ougrée and is now using such fuel in five boilers and fourteen steel heating furnaces. In certain types of furnaces it is claimed that a fuel economy of 50 per cent. is being secured.

THE first approval of a portable electric plant for use in gaseous mines has been given by the United States Department of the Interior, through the Bureau of Mines, and covers a special locomotive-type truck containing battery cells of sufficient number and capacity to operate a coal-cutting outfit. The advantages claimed for the portable power plant are that it permits the elimination of feeder circuits and gives more rapid and satisfactory operation of the mining machine, owing to uninterrupted power supply and non-fluctuating voltage conditions.

IT is estimated that there are at present about 200,000 electric-cap lamps in use in American mines. In 1911 about 45,000 flame lamps but no electric lamps were being used in the Pennsylvania bituminous mines, which were then producing 35 per cent. of all the soft coal mined in the country; by 1918 the number of flame lamps had decreased to 17,000, whereas electric lamps totalled nearly 48,000. In Great Britain during the same years the total of 723,934 flame lamps decreased to 590,185 and the electric lamps gained rapidly from 4298 to 156,521.

AN ingenious administration has decided to add yet another trial to the many already borne with humble resignation by Parisian telephone subscribers, states the *Daily Telegraph's* Paris correspondent. In future, when a subscriber calls the exchange, a number will appear over his disc on the operator's board to indicate his turn in the waiting list. As each appeal is answered, the subscriber who started twelfth in order will gradually move nearer to number one, but should he, in protest against delay, tap the hook, the number of his turn will automatically disappear, and he will have to begin again at the end of the waiting list.

THE London General Omnibus Company research department has for some time been experimenting with an aluminium alloy road wheel, which, although only half the weight of the standard steel wheel, has, we learn, given exceptionally satisfactory results. A number of these wheels, we are informed, have now performed over 30,000 miles on service, and tests are continuing on upwards of twenty routes. The economic advantage which the aluminium wheel possesses is that the scrap value is about two-thirds of its original casting value. A further great advantage is the big reduction in unsprung weight and the minimising of road destruction.

THE Ministry of Transport and Public Works has entered into additional contracts in connection with the improvement of the Rio de Janeiro Docks. Although constructional improvements in the form of lengthened quays were decided upon as far back as 1920, progress towards completion has hitherto been slow. The new work now to be undertaken is supplementary to the contracts entered into for the free port to be established on the Ilha do Gobernador, situated on the inner part of Rio Harbour at about four miles from the chief landing place. The amended plans call for an extension by 1391 m. of the present quay, which will increase the accommodation capacity by nearly 40 per cent. In addition to these main operations, important contracts have yet to be completed in connection with port works at Port Natal, Rio-do-Norte, which call for an expenditure of £200,000; and harbour works at Recife—Pernambuco—entailing an outlay of £1,864,750.

# LEAFIELD WIRELESS STATION—COUPLED CIRCUIT

THE POST-OFFICE ENGINEERING DEPARTMENT, LONDON, ENGINEERS

(*For description see page 155*)

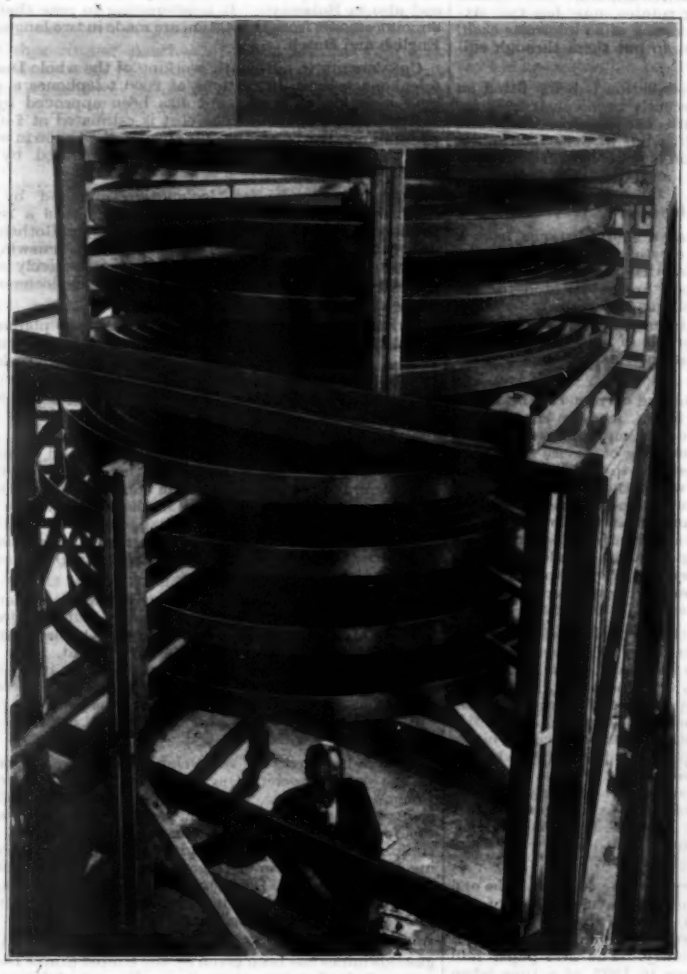


FIG. 2—PRIMARY INDUCTANCE

FIG. 3—VARIABLE COUPLER

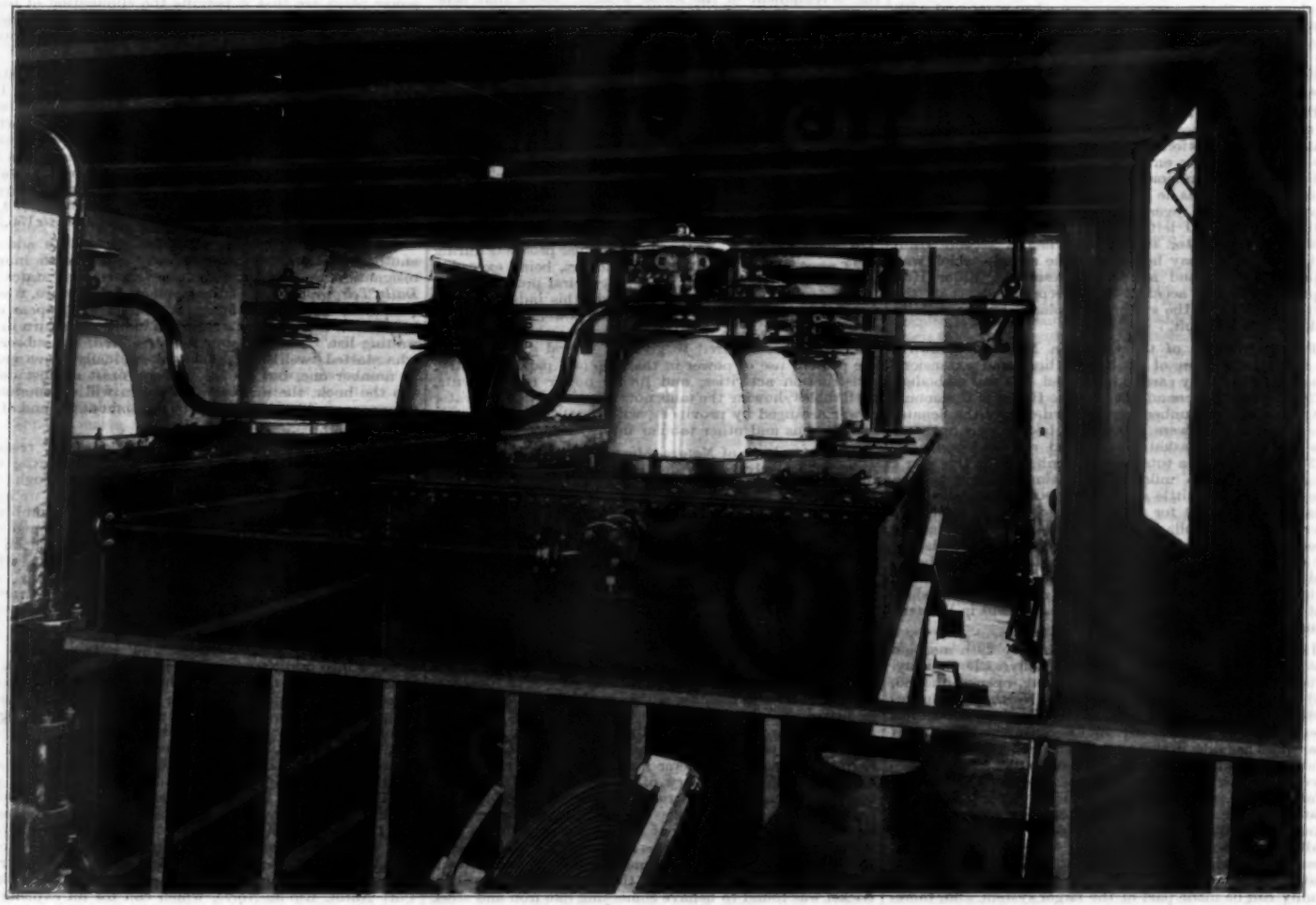


FIG. 4—TOPS OF CONDENSER UNITS

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# THE ENGINEER.

*AUGUST* 8, 1924.

### Railway Track.

THE subject dealt with in this week's portion of our article, "One Hundred Years of British Railways," is that of the track. The development of the rail from one of timber to one of cast iron and then to the use of malleable iron is traced, as is also the transition from a rail without a flange to the plate way with a flange, and finally to the edge rail which required the flange to be upon the wheel. In previous articles it has been shown that wagon ways were in existence as far back as the middle of the sixteenth century, so that as iron was not employed for rails until about 1767, railways—using the present-day name for wagon ways—were over two hundred years old before iron rails were introduced. It is fitting, therefore, that, at this time, we should draw attention to some remarks made by Robert Stevenson of Edinburgh—the grandfather of Robert Louis Stevenson—in the year 1818. That celebrated engineer, in reporting on a proposed railway to Edinburgh and Leith, said "such are likely to be the benefits resulting from this discovery—the use of cast iron rails—that we doubt not, as this system develops itself, the name of the person who first conceived the idea will eagerly be sought for and honour done to him as to one of the greatest benefactors of his country." As a matter of fact, few are aware of whom Stevenson was speaking, but we hope that as a result of the visit of the Newcomen Society to Shropshire in June last it will be more widely known that this "one of the greatest benefactors of his country" was William Reynolds, a partner in the Coalbrookdale Ironworks. Equal honour should, we suggest, be shown to William Jessop—one of the founders, in 1790, of the Butterley Iron Company—as the inventor, in 1789, of the edge rail. This idea made, at first, less progress than the plate way designed by his partner, Benjamin Outram, because, no doubt, it needed the flange to be on the wheel instead of on the rail. Jessop's edge rail is, however, the prototype of the rail of to-day, and his name and that of Reynolds should not be overlooked at this time.

In its general principles the modern track bears a strong likeness to that found in the early railways. The greatest change was made when steel rails were substituted for cast iron. Some of the first steel rails were laid at Chalk Farm in 1862. The length has been increased from 12ft. or 15ft. to 60ft. with 45ft. as the standard in the United Kingdom and 33ft. in the United States, whilst the weight has risen from 35 lb. per yard to 100 lb. The disadvantages of a light rail were early seen, and rails weighing from 60 lb. to 65 lb. per yard were being used in 1840. The shape of the rail of to-day is much the same as that of those which were used on the old London and Birmingham line, except that the latter were double-headed, so as to be capable of being turned, and therein they differed from the bull-headed rail, introduced fifty years ago, and now the British standard for use in chaired roads. The chair, again, but with a metal key, was used on the earliest steam-worked railways, whilst the oak key was introduced by Locke on the Grand Junction. The flat-bottomed rail—practically the only alternative to the bull-headed—was designed by Vignoles in 1836. Singular to relate, Great Britain is the only country that adheres wholly to the chaired road; even in Ireland it is rarely met with. Rails certainly are better held in position when fixed in chairs, but the practice is somewhat a survival of the desire for a rigid road. It is, moreover, open to question whether chairs would continue to be used here were an opportunity to present itself to re-cast the whole design of our track, and that could be done without casting reflections on the previous policy. The joining of the rails together by fish-plates was introduced by W. Bridges Adams in 1847, and still survives. It cannot, though, be regarded as furnishing a perfect joint, as no means have yet been devised of satisfactorily supporting the adjoining ends of the rails. Birkinshaw, by the way, when, in 1820, patenting the mode of making the first successful malleable iron rail, proposed to weld the ends together. Mitre ends were also used in those early days, and they rested in the same chair. For carrying the rails, whether in chairs or on bearer plates, the sleeper road is universal. Longitudinal timbers—used, be it noted, in the Glenfield Tunnel on the Leicester and Swannington Railway in 1832, and therefore before Brunel built the Great Western—are now only used in exceptional cases. They were found not to give the lateral strength to be experienced in the cross-sleeper road. Timber is used for sleepers almost universally. Where, as in India, climatic conditions or the ravages of the white ant, called for constant renewal of wooden sleepers, metal ones have been adopted. Steel sleepers are, however, costly and difficult to pack and keep adjusted, whilst reinforced concrete has not yet been found to withstand the vibration of trains. In ballasting there has, perhaps, been the greatest improvement of all, and it has been recognised that a clean stone ballast not only gives a better road but also, by not raising so much dust, interferes less with the bearings of the engines and rolling stock and causes less discomfort to passengers.

The moral to be drawn from these comparisons between the track of to-day and of that of the early railways is that, except in detail, the principle is the same. Credit is, therefore, due to other railway pioneers than the builders of locomotives. Credit, too, must be given to their successors—the various civil engineers of our railways—who, without departing from the original principles, have been able to strengthen the track so as to take the gradually increasing axle loads and the growing traffic. That they have been successful in their efforts is proved by the fact that during the last forty years, despite the unparalleled density of traffic on the nearly forty thousand miles of main line, only in four years have the accident returns shown over 300 cases of broken rails in a year.

### Proposed Combination of Steel Producers.

EFFORTS have been made from time to time by steel firms on the Continent, sometimes in association with British producers, to come to some international agreement for the maintenance of prices. The situation has been rendered so bewildering by the monetary fluctuations and by the dislocation of the economic relations which formerly existed amongst nations that it has become quite impossible to do business on normal lines. It was, therefore, hoped that a pooling of interests amongst countries doing an export trade would have the effect of stabilising business by removing the speculative element which enabled foreign consumers to depress the market. Those negotiations failed because, while all had an interest in maintaining prices, some believed that they were in a better position to secure a large share of the business than others. Since then the aspect of affairs has changed so completely that a section of continental steel firms believes that the time has come to carry some international agreement into effect. The state of matters is particularly acute in Belgium, where the steel industry has fallen upon exceptionally

bad times. The throwing down of the barriers between Belgium and the Grand Duchy of Luxemburg, while it was regarded with favour politically, has actually proved anything but beneficial to the Belgian industry. As Belgian firms depend almost entirely upon an export demand, they find that the open door from Luxemburg has let in a disquieting competition, and the situation has not been improved by the refusal of the Luxemburg steel producers to agree to any proposal for a control of output with a view to a maintenance of prices. The trouble has, in fact, become so acute that some Belgian steel firms are, it is stated, preparing to close down their works. If they have not already done so, it is owing largely to the pressure of Government, which fears that the throwing of so many men out of work may cause trouble. With prices cut so low by competition, it is certain that some firms will not be able to carry on indefinitely.

If the Belgians were the first to feel the effects of a sudden contraction in foreign buying the French are now beginning to experience a difficulty in disposing of their surplus production abroad. The restoration of Lorraine so largely increased the steel production that makers have to look more and more to the requirements of foreign markets, and, while an appearance of prosperity was imparted to the industry by speculation during the early period of the slump in currency values, the markets abroad have absorbed so much metal that they appear incapable of purchasing any more. There is a saturation that will last so long as the world's industrial situation remains in its present state of stagnation. The demand has consequently fallen for the moment considerably below the production, and when French and Belgian firms regard the future they see competition, not from Germany, which has been shorn of one of its most valuable industrial regions, but from the United States, and it is feared that the rapid development of the steel-making industry in that country will compel its manufacturers to look to European markets for the disposal of their products. Whatever justification there may be for this fear of American competition it is certainly affecting the outlook of continental firms, which are seriously considering the advisability of organising a "cartel" or combination of steel producers. The Belgians are endeavouring to effect a combination to regulate production and control prices, and if they succeed in doing that with the co-operation of Luxemburg producers, it is reported that an attempt will be made to bring in the French and ultimately the other continental steel firms.

In view, however, of the complexity of interests involved it is extremely doubtful whether negotiations of that kind could be carried to a successful issue. So far as the Belgians are concerned, it is certain that something must be done to save the position from becoming dangerously acute, but that cannot be accomplished by co-operation with other countries, which prefer to preserve their liberty rather than to accept conditions of control and obligations which will offer positive drawbacks for doubtful advantages. The fact of the "cartel" being discussed so freely on the Continent is evidence of the unsatisfactory condition of the steel trade and of the apprehension with which producers are looking to the future; but it does not appear as if any of the suggestions being made will alter a situation arising out of a super-production at a time when the consumption has suddenly declined. The problem does not admit of a solution by a foreign agreement so long as some countries consider that they are not so badly hit by the crisis as others and can, therefore, afford to stand alone, and the only remedy would seem to lie in momentarily restricting production until the efforts now being made to ensure an industrial reconstruction of Europe have given positive results.

## Literature.

*The Specific Heats of Gases.* By J. R. PARTINGTON, D.Sc., and W. G. SHILLING, M.Sc. London: Ernest Benn, Limited. Price 30s.

WHILE in this book the authors have set themselves the task of providing for the use of the designer or the expert in various branches of technology the most accurate data available relating to the specific heats of the gases with which he may be concerned, as a matter of fact, a very great deal more information on the thermal properties of gases is given than that relating simply to specific heats. The book contains voluminous tables of specific heats as determined by numerous authorities, and further tables of what, after examination and selection, are considered to be the most reliable figures for many gases, but it is by no means a mere reference book. It may, indeed, be regarded as a treatise on the thermal properties of gases in general.

The characteristics of gases with regard to their pressure, volume and temperature relationships are discussed, and the equations of state proposed by a host of physicists are quoted. The experimental methods employed for the determination of specific heats, either directly or indirectly from correlated properties, are described, and the work of, and the results obtained by, the leading authorities are critically discussed. Much of this part of the book will appeal more to the pure scientist than to the technical man, though the engineer interested in internal combustion engines will find of particular interest the discussion of the classical work of Bunsen, Mallard and Le Chatelier, Clerk, Hopkinson, Petavel and other investigators of the phenomena of combustion, dissociation and specific heat of gases at high temperatures, particularly with reference to what happens when a gaseous mixture is exploded, what temperatures and pressures are attained, and what is the rate of loss of heat to the walls of the containing vessel.

The specific heat of steam is less fully discussed, though the work of Grindley, Knoblauch and Jacob, Callendar, Thomas and others is concisely surveyed. A chapter is devoted to the kinetic theory of gases and to the quantum theory of Planck. Copious references to the original publications of the authorities quoted and discussed are given, and a full bibliography is also included. Charts are given showing the molecular heats at different temperatures of the more common gases of industrial importance and of steam.

The chapter dealing with applications of the accurate knowledge of specific heats of gases to questions arising in the theory of internal combustion engines, furnaces, gas producers and refrigerators is one to which the engineer will turn with lively anticipation. It is to be feared, however, that a feeling of disappointment will be experienced with regard to all but the internal combustion engine section of this chapter.

The important bearing of accurate specific heat data on the determination of the limits of efficiency of internal combustion engine cycles is well recognised, and is of particular moment when, as at present, new standards of efficiency are under consideration. Messrs. Partington and Shilling give an excellent survey of the effect on the standard efficiency of the adoption of equations for specific heat proposed by Clerk and by Wimperis, and show an example of comparative diagrams, one as actually obtained in an engine, one representing the air cycle, and one as calculated for an ideal gas engine mixture by Hopkinson's method, which is adequately explained. The authors then proceed to describe the later investigations of Tizard and Pye, from which temperatures can be calculated for an actual cycle, which agree remarkably well with practice.

In the section on furnaces, the authors are concerned simply with the heat leaving the furnace in the hot products of combustion; they are evidently disturbed in mind by the fact that inaccuracy of data has frequently led to this source of loss being imperfectly appreciated. The blast-furnace is also referred to, a heat balance sheet being quoted from which it is deduced that for each 1000 tons of pig iron produced, the surplus blast-furnace gas—*i.e.*, the gas remaining after providing a sufficient quantity for hot blast stoves and presumably for generating power for blowing—if used in gas engines could develop 615,000 brake horse-power-hours. The authors understate the case here, for in a quite typical case, if gas engine-driven blowers are used, 6 per cent. of the total blast-furnace gas suffices for the blowing engines and 45 per cent. for the hot blast stoves and usual losses, and instead of 615,000 brake horse-power-hours, about 900,000 brake horse-power-hours per 1000 tons pig could be generated in modern gas engines. Even this figure could be considerably increased if steam were generated in special boilers, through which the exhaust gases were passed. The authors suggest that not only the fuel value of blast-furnace gas should be utilised, but that its sensible heat should be used for steam generation; but give no hint as to the method to be employed for the purpose.

Dealing with boiler furnaces, the authors deplore the large loss of heat due to the flue gases escaping at 300 deg. Cent. (572 deg. Fah.). They evidently assume that the loss is measured by that heat which would be obtained if the gases were cooled from 300 deg. to 0 deg. Cent.; but power station engineers will join issue vigorously with them as regards both these temperature limits, and will seek to bring to their notice modern practice in recovery of heat by economisers and air heaters.

In the section on gas producers, the authors merely point out how the sensible heat of the gas generated may be calculated, and in that on refrigerators they only re-state the well-known argument to show the advantage of dividing the compression into stages and using intercoolers. These last-named sections add little of value to the book. Naturally, however, "applications" are rather beyond the scope of the authors' purpose, and weakness here is excusable.

The undeniable merit of the book lies in its exhaustive and critical survey of the methods and results of investigations on the thermal properties of gases, and its presentation of the laws of gases. Particularly valuable to the engineer is its excellent account of the study of explosive mixtures in closed vessels and in engines. The authors have avowedly written for the expert, and while it is only to the expert that much of the book can have any appeal at all, they have done admirable work in collecting for the use of the technologist information otherwise scattered throughout an immense diversity of scientific publications, and in subjecting it to enlightened criticism, classification and correlation.

## The Gauging of Finish-ground Worms by Cylinders.

By HENRY E. MERRITT, M.Sc. (Eng.).

THE high degree of accuracy to which worm threads may be produced by a grinding process demands an equally accurate means of gauging the threads. One of the simplest and most convenient ways in which this may be effected consists in placing a cylinder between adjacent thread surfaces and checking it for position, and this principle appears to be in use chiefly as the basis of a comparative method, using a master worm as a standard of reference. In the present article it is proposed to show that from certain fundamental worm dimensions the size and position of a cylinder to gauge any point on the thread contour may be calculated, and in spite of the apparent difficulty of the problem, the solution is very simple and easy of application.

*Contact Between Worm Thread and Abrasive Wheel.*—The form of thread considered is that of a parallel worm whose threads are produced by grinding them with the plane face of an abrasive wheel. The thread contour is then controlled only by the lead of the worm and the position of the abrasive plane (referred to subsequently as the plane) relatively to the axis of the worm, and this may be defined by assuming that while the axis of the worm is horizontal, the axis of the abrasive wheel may be rotated in a vertical plane parallel to the worm axis. Under these conditions a horizontal line contained by the surface of the wheel and intersecting the worm axis will be normal to the latter, as shown in Fig. 1, and the relative position of the plane and the worm axis is determined by the angle $a_o$, the inclination of the plane to the horizontal.

In order to arrive at the contour of the thread it is necessary to determine the line along which contact between the thread and the plane occurs. In the figure 0 represents the worm axis in end view and $a\,a\,a\,a$ a portion of the plane. This plane is represented in the right-hand view by the line $a_1\,a_1$. Now, assume that contact occurs at the point P. Let the length of the normal O P from P to the worm axis be $r$, and let its inclination to the horizontal be $\theta$.

Now the helix contained by the thread surface at radius $r$ must be tangential to the plane at P, hence if the worm rotate a small amount $d\,\theta$ the displacement of the point P in the worm surface will take place in the plane $a\,a\,a\,a$.

Let the lead of the thread be denoted by L. Then the axial component of the displacement of the point P will be $z = \mathrm{L}\,.\,d\,\theta/2\,\pi$, while the circumferential component will be $y = r\,.\,d\,\theta$. But the vertical component will be $z = y\,.\cos\theta = r\,.\,d\,\theta\,.\cos\theta$, while $z/x = \tan a_o$.

$$\text{Hence } \tan a_o = \frac{r\,.\,d\,\theta\,.\cos\theta}{\mathrm{L}\,.\,d\,\theta/2\pi} = 2\,\pi\,r\,.\cos\theta/\mathrm{L}$$

$$\text{and } r = \mathrm{L}\,.\tan a_o\,/2\,\pi\,.\cos\theta.$$

Now a helix whose helix angle is $a_o$ will be described on a cylinder whose radius is $r_o$, the value of $r_o$ being such that $r_o = \mathrm{L}\,.\tan a_o\,/2\,\pi$. Substituting this value gives

$$r = r_o\,.\sec\theta,$$

and therefore P must lie in a plane distant $r_o$ from the axis of the worm. Hence contact between the plane and the worm occurs along a straight line tangential to a cylinder of radius $r_o$ and inclined at an angle $a_o$ to the plane containing the worm axis and the point of tangency; and the thread surface may be regarded as being swept out by this line as it describes a helical path of lead L.

*Transverse Section of Thread.*—Inasmuch as the thread surface at P lies in the plane $a\,a\,a\,a$, a transverse section of the thread at P will be such that a normal to the thread section at P will be vertical and therefore tangential to the cylinder of radius $r$. This will be true for all points on the thread, and the profile of the thread on the transverse section is thus seen to consist of an involute whose base cylinder has a radius of $r_o$.

*Axial Section of the Thread.*—The axial section of the thread, *i.e.*, a section on a plane containing the axis of the worm, may be derived from a consideration of the movement of the generating line.

Thus in Fig. 2 let K be the point at which the axial section meets the base cylinder, K M N being the helix described by the point of tangency of the generating line. Now consider the position of the generating line when it has rotated through an angle $\theta$,

It will now intersect the profile on the axial section at some point P, while the point of tangency will have moved an axial distance equal to $\theta L/2\pi$. But the projected length of the line P M in the axial direction will be $a = P_1 M_1 \cot a_o$, and since $P_1 M_1 = r_o \tan \theta$, we get $a = r_o \tan \theta / \tan a_o = \frac{L}{2\pi} \tan \theta$.

Hence the axial displacement $x$ of the point P relatively to the origin K will be such that

$$\frac{\theta L}{2\pi} + x = a.$$

$$\therefore x = a - \frac{\theta L}{2\pi} = \frac{L}{2\pi} \tan \theta - \frac{\theta L}{2\pi},$$

$$i.e., x = \frac{L}{2\pi} (\tan \theta - \theta).$$

The radius $r$ of the point P may be expressed in terms of $r_o$ and the third variable $\theta$, since $r = r_o . \sec \theta$.

If the sides of two adjacent threads meet the base cylinder along helices, the axial distance between which is denoted by $b$, then the axial space between the thread surfaces at radius $r$ will be given by

$$t_w = 2x + b.$$

*Location of a Cylinder Between the Threads.*—In Fig. 3 let $a\,b$ and $a_1\,b_1$ be positions of the respective generating lines of the surfaces of two adjacent threads, intersecting the vertical axial plane at $a$ and $a_1$ at the same radius $r$. Then the distance $a\,a_1$ may be calculated as shown above.

Now consider the positions of the generating planes when contact occurs along the lines $a\,b$ and $a_1\,b_1$. Inasmuch as contact takes place at $a$ in the vertical axial plane, a horizontal section of the generating plane will give a line which must be tangential to the helix in the thread surface passing through $a$. If the helix angle of this helix be $\alpha$, the value of this quantity will be such that $\tan \alpha = 2\pi r/L$. If the generating plane be viewed horizontally in a direction inclined at the said angle $\alpha$ to the worm axis it will appear as a straight line $a_2\,b_2$, and since contact between the plane and the thread only occurs along the line $a\,b$ the thread itself will appear to have straight sides.

Now if hypothetical plane surfaces be regarded as lying in the two positions of the generating plane, any cylinder might be placed between these two planes and would make contact with them along two straight lines parallel with the axis of the cylinder, which would then make an angle $\alpha$ with the worm axis. Contact between the cylinder and the worm thread, however, can only occur at two points which are common to the lines of contact of the cylinder and planes and the planes and thread respectively. In order that the cylinder may remain in contact with the thread surface at these points without restraint when the planes are removed, the points of contact must be at their minimum distance apart and both must therefore be contained in a plane perpendicular to the axis of the cylinder.

Further, if $c$ (Fig. 3) is the mid point of the axial space $a\,a_1$, the plane normal to the axis of the cylinder must pass through this point and will intersect the generating lines at the points $d\,d$. These are the only points of contact which will allow the cylinder to remain at an angle $\alpha$ to the worm axis. It only remains, therefore, to determine the diameter and the position of the axis of the cylinder.

Now, inasmuch as contact only occurs in the normal plane $d\,c\,d$, the cylinder may be replaced by a sphere of equal diameter and this sphere would also touch the threads at the points $d\,d$. But if a section of the sphere and thread on a plane normal to the worm axis and containing the point of contact $d$ be considered, the section of the sphere will give a circle while that of the thread will be an involute to the base cylinder. There must, however, be a common normal at the point of contact, and this common normal passes through the point $c$. Hence the centre of the sphere and the axis of the cylinder will respectively coincide with, and pass through, the point $c$.

To determine the diameter of the cylinder, revert to the view of the threads along a line making the angle $\alpha$ with the worm axis. In this view the sides of the threads are represented by the straight lines $a_2\,b_2$, and since the axis of the cylinder has been shown to pass through the point $c_2$, the true length of the radius of the cylinder will be the perpendicular distance $c_2\,d_2$ from $c_2$ to the line $a_2\,b_2$.

Let the inclination of the line $a_2\,b_2$ to the vertical be denoted by $\psi$. Now on a section normal to the worm axis the inclination of the generating plane will be $\theta$, while on the plane $d\,c\,d$ the inclination of the generating plane is $\psi$. From the figure, however,

$$\text{Tan } \psi = d_2 f_2 / c_2 f_2 = c_1 f_1 / d\,c,$$

and

$$\tan \theta = c_1 f_1 / d_1 f_1 = c_1 f_1 / d\,c,$$

and since $d\,c = d\,c . \cos \alpha$,

$$\tan \psi = \tan \theta . \cos \alpha.$$

Since $\alpha_o$ is constant for a given worm, it is seen that the diameter of the cylinder is directly proportional to the axial space between the thread surfaces at a radius equal to the distance between the axes of the worm and cylinder.

*Summary.*—The foregoing conclusions may be summarised for ease of reference as follows:—

Let a worm be produced by a plane making an angle $\alpha_o$ with a plane containing the axis of the worm when the intersection of the planes is normal to the worm axis.

Then if the lead of the worm is L the transverse section of the thread is an involute to a cylinder of radius

$$r_o = \frac{L . \tan \alpha_o}{2\pi}.$$

On a section containing the worm axis the thread profile is such that at radius $r$ the axial displacement measured from the origin on the base cylinder will be

$$x = \frac{L (\tan \theta - \theta)}{2\pi},$$

where $\theta = \cos^{-1} \frac{r_o}{r}$.

The axial space between the sides of adjacent threads at radius $r$ is given by

$$t_{xr} = 2x + b,$$

where $b$ is the axial distance between the thread profiles on the base cylinder.

If a cylinder be placed between two adjacent threads, the distance between the axes of the worm and cylinder being $r$, then the angle between the said axes when viewed along the common perpendicular will be given by

$$\alpha = \tan^{-1} \frac{2\pi r}{L},$$

and the cylinder will occupy a stable position provided that its diameter is

$$e = t_{xr} \sin \alpha_o.$$

Fig. 1

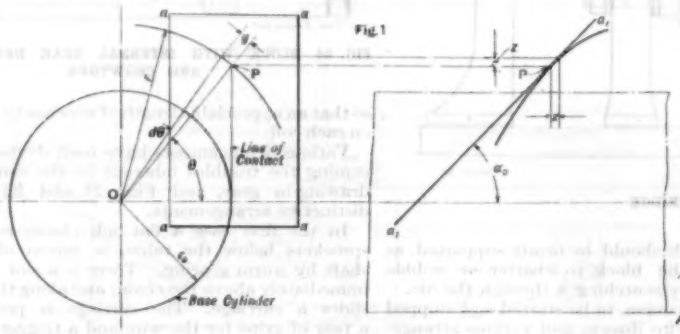



Fig. 2

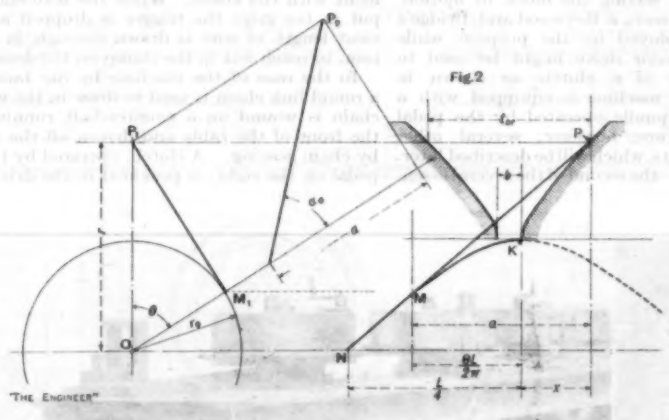
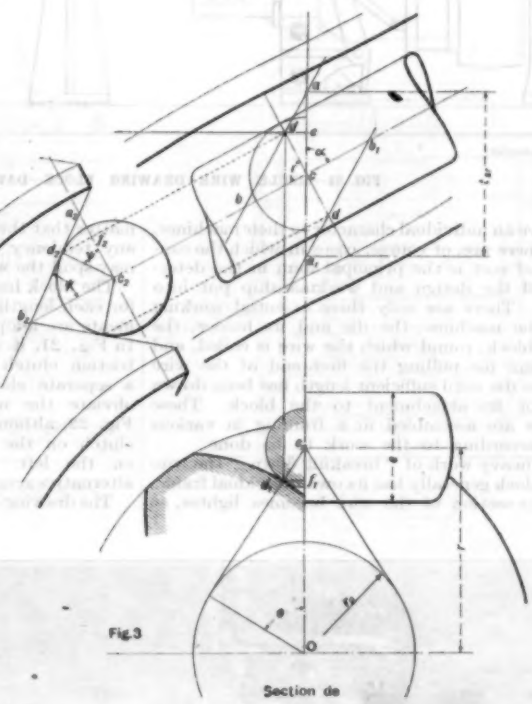



Fig. 3




Let $e$ be the diameter of the cylinder. Then

$$e = 2 c_2 d_2 = 2 a_2 c_2 . \cos \psi = 2 . a\,c . \sin \alpha . \cos \psi.$$

$$\therefore e = t_{xr} . \sin \alpha . \cos \psi.$$

This expression may be very much simplified as follows:—The connection between the angles $\alpha$ and $\alpha_o$ is

$$\tan \alpha = \tan \alpha_o . \frac{r}{r_o}.$$

$$\text{But } \frac{r}{r_o} = \sec \theta, \text{ hence}$$

$$\tan \alpha = \tan \alpha_o . \sec \theta.$$

It is now required to substitute the quantity $\alpha_o$ for the variables $\alpha$ and $\psi$, and it will be found that the third variable $\theta$ completely vanishes.

Thus squaring

$$e^2 = t_{xr}^2 . \sin^2 \alpha . \cos^2 \psi.$$

But

$$\cos^2 \psi = 1/1 + \tan^2 \psi = \frac{1}{1 + \tan^2 \theta . \cos^2 \alpha},$$

and similarly

$$\cos^2 \alpha = \frac{1}{1 + \tan^2 \alpha_o . \sec^2 \theta}$$

$$\sin^2 \alpha = \frac{\tan^2 \alpha_o . \sec^2 \theta}{1 + \tan^2 \alpha_o . \sec^2 \theta}$$

$$\therefore e^2 = t_{xr}^2 \left[ \frac{\tan^2 \alpha_o . \sec^2 \theta}{1 + \tan^2 \theta . \sec^2 \theta} \right] \times \left[ \frac{1 + \tan^2 \alpha_o . \sec^2 \theta}{1 + \tan^2 \theta + \tan^2 \alpha_o . \sec^2 \theta} \right]$$

$$= t_{xr}^2 \left[ \frac{\tan^2 \alpha_o}{1 + \tan^2 \alpha_o} \right]$$

$$\therefore e = t_{xr} . \sin \alpha_o.$$

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A NEW experimental iron blast-furnace has been completed and blown in at the Minneapolis experiment station of the American Bureau of Mines. The new experimental furnace is larger than the one constructed by the Bureau of Mines at Minneapolis last year, which was the first successful experimental blast-furnace in the history of metallurgy. It is expected that metallurgical studies made possible by the construction of the new blast-furnace will reveal valuable information relative to the production of spiegel iron from manganiferous iron ores, which cannot be smelted under present practice. Since the United States has tremendous reserves of these manganiferous iron ores, the problem of their successful smelting is one of great importance to the iron industry. The furnace, which was erected in co-operation with the University of Minnesota, is 36in. in diameter at the hearth and 30ft. high. The first run lasted ten days. Air was supplied to the furnace at the rate of about 600 cubic feet per minute, about 8 tons of coke per day being consumed. From 15 to 20 tons of spiegel iron of varying manganese content were produced during the experiments. Several hundred gas samples were taken from the interior of the furnace shaft by means of water-cooled sample tubes. The most striking feature of the furnace experiment in contrast with previous tests lies in the fact that a fairly complete survey of the composition of the gas stream in the furnace shaft is possible.

# British Wire-drawing and Wire-working Machinery.

No. IV.—WIRE-DRAWING BLOCKS.*

THE machines used for drawing heavy gauge wire are generally referred to as wire-drawing blocks, but the significance of the name is rather puzzling, unless it has some relation to the term pulley block, which is quite possible, seeing that the purpose of the block is to pull the wire through the die.

The general outline of all wire-drawing blocks is much the same, although minor variations are introduced by different makers, largely, it would seem, to give an individual character to their machines, although there are, of course, cases in which the consideration of cost is the principal item in the determination of the design and workmanship put into the block. There are only three essential working parts in the machine—the die and its holder, the drum-like block, round which the wire is coiled, and a mechanism for pulling the first end of the wire through the die until sufficient length has been drawn through for its attachment to the block. These three units are assembled in a framing in various fashions, according to the work to be done.

For the heavy work of "breaking down" the wire rod each block generally has its own individual frame, and, as the section of the wire becomes lighter, so more blocks are grouped in one frame. The reason for this arrangement is fairly obvious, as the breaking down pass requires much more power than the subsequent drawings, while a greater length of material has to be handled after each pass. As a consequence, one breaking down block can serve several lighter blocks.

Figs. 21 and 22 give a good impression of two typical single wire-drawing blocks. The drawing—Fig. 21—shows the general arrangement of a machine made by David Bridge and Co., of Castleton, near Manchester, while the half-tone engraving is of one by Sir James Farmer, Norton and Co., of Salford.

* No. III. appeared August 1st, 1924.

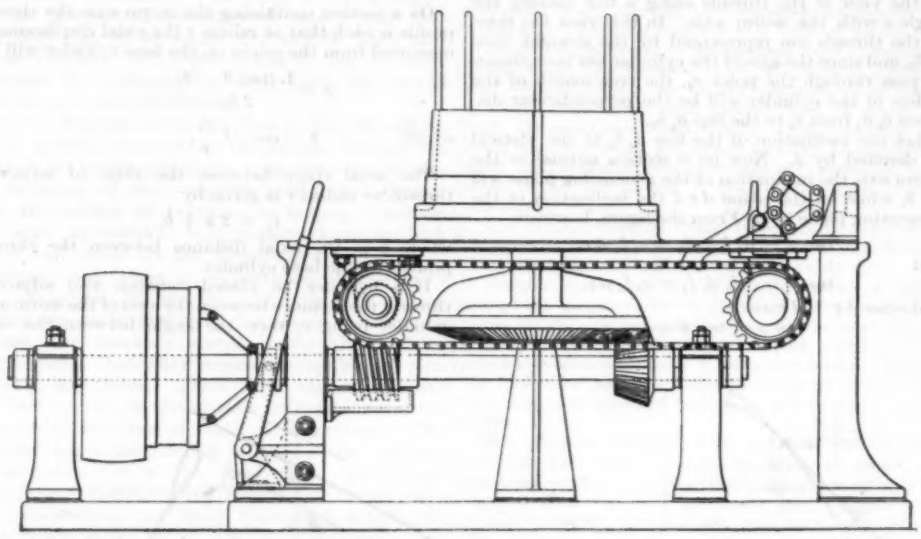



FIG. 21—SINGLE WIRE-DRAWING BLOCK—DAVID BRIDGE

The block, it will be seen, is mounted on a vertical spindle and is driven from a horizontal shaft by bevel gearing. In some designs—such as that shown in Fig. 22 for instance—the block spindle is carried right down to the base of the machine, and a footstep bearing is arranged there, while in others the footstep is placed above the horizontal shaft, on a stool or A frame. It is a matter of opinion as to which arrangement is the better, as, while the first has the advantage of providing a very rigid support for the block, it leaves the gear wheels vulnerable to any falling rubbish. With the wheels inverted—as in Fig. 21—the gear teeth are much better protected, but the distance between the spindle bearings is greatly reduced, and it is a most important matter that the block should be firmly supported, as any tendency for the block to chatter or wobble may spoil the wire by snatching it through the die.

The block has, of course, to be started and stopped for each length of wire drawn, and various arrangements are adopted for setting the block in motion. In Fig. 21, it will be seen, a Heywood and Bridge's friction clutch is employed for the purpose, while a separate electric motor drive might be used to obviate the necessity of a clutch—as shown in Fig. 22, although this machine is equipped with a clutch on the block spindle operated by the pedal on the left. There are, however, several other alternative arrangements, which will be described later.

The drawing-in gear—the second of the several essential parts of the machine mentioned above—on the two machines under review is quite different, and it is in this direction that some of the most marked variations in design are found.

The old-fashioned drawing-in mechanism, and it is one still very largely used, specially in the Birmingham district, comprises a large cam mounted on the block spindle immediately beneath the block itself. A lever pivoted to the back of the machine and lying on the table can be brought to bear against this cam, and will then be reciprocated as the cam rotates. On the front end of the lever there is a short length of chain provided with a pair of tongs for gripping the wire.

To use this gear the wire drawer pulls the chain towards the pointed end of the wire protruding through the die, and, as the cam rotates continuously, there is a time in every revolution when he can catch the grips on to the wire. The lever is then pushed forward by the cam and pulls a short length of wire through the die. The man then has to return the grips to the die to get another hold, and so on until sufficient wire has been drawn through to reach to the clamp on the block. The cam lever then lies idle on the table, clear of the cam, so that it does not go on working when not required. The mechanism is obviously very brutal in its action, as the lever swings back with considerable violence, and if the man fails to fasten the grips on the wire at the critical moment that stroke of the lever is wasted. Added to this objection there is the intermittent nature of the action, which results in a series of marks on the wire where new grips have been taken,

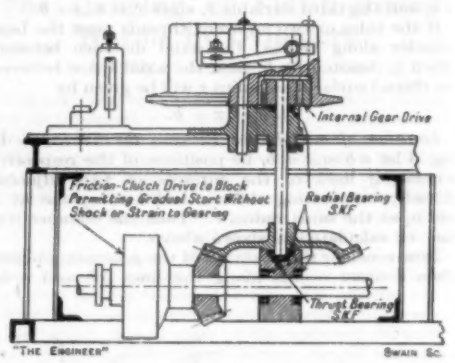

Internal Gear Drive
Friction-Clutch Drive to Block Permitting Gradual Start Without Shock or Strain to Gearing
Radial Bearing S.K.F.
Thrust Bearing S.K.F.
"THE ENGINEER"
SWAIN Sc.

FIG. 24—BLOCK WITH INTERNAL GEAR DRIVE—BARRON AND CROWTHER

so that an appreciable length of wire has to be scrapped on each coil.

Various arrangements have been devised for overcoming the troubles inherent to the cam and lever drawing-in gear, and Figs. 21 and 22 show two distinctive arrangements.

In the first case a flat-link chain, running over sprockets below the table, is driven off the main shaft by worm gearing. There is a slot in the table immediately above the chain, and along this slot there slides a carriage. The carriage is provided with a pair of grips for the wire and a trigger for engagement with the chain. When the wire end has been put in the grips the trigger is dropped and a sufficient length of wire is drawn through, in one operation, to reach out to the clamp on the drawing block.

In the case of the machine by Sir James Farmer a round link chain is used to draw in the wire. This chain is wound on a countershaft running beneath the front of the table and driven off the main shaft by chain gearing. A clutch, operated by the cranked pedal on the right, is provided in the drive, and this clutch is interconnected with the lever which can be seen standing up in front of the chain guide pulley. The chain passes through the eye at the top of this lever and pulls the clutch out of engagement at the end of the stroke, so that the gear cannot be smashed by carelessness on the part of the operator. This machine, by the way, has a block 22in. in diameter, with a peripheral speed of about 60ft. per minute, and is driven by a 20 horse-power motor.

The die holder, the third essential part of the wire-drawing machine, requires little comment, as it generally takes the form of a simple bracket in which the die is held by a variety of means, such as set screws or wedges, while it is sometimes merely a slotted plate against which the die bears under the pull of the wire.

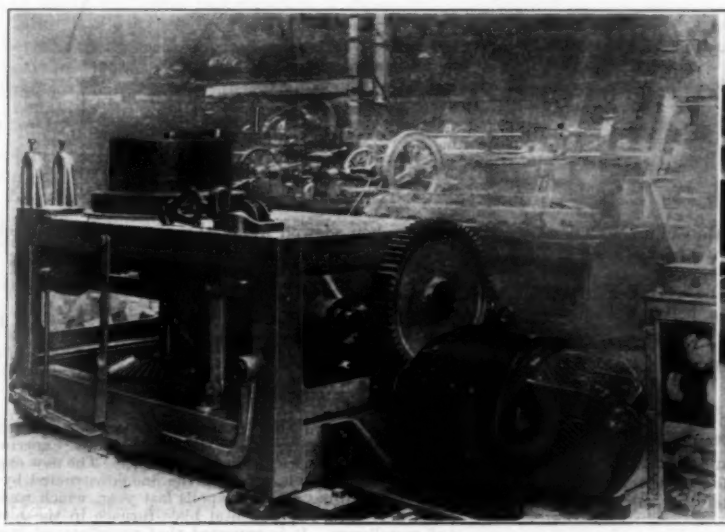


FIG. 22—SINGLE BLOCK—SIR J. FARMER

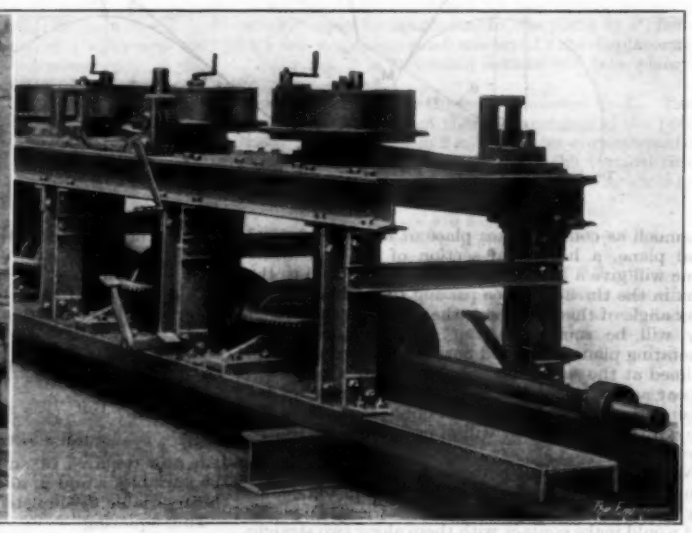


FIG. 23—STEEL-FRAMED MACHINE—BARRON AND CROWTHER

In drawing heavy wire dry powdered soap is generally used as a lubricant for the wire as it enters the die, and the soap is held in a box, or funnel,

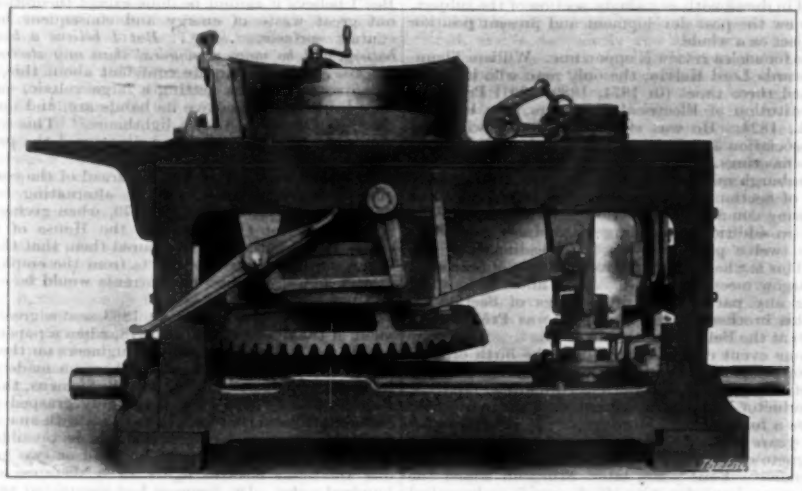


FIG. 25—HEAVY WIRE-DRAWING BLOCK WITH FRICTION DRIVE—G. CROSSLEY

through which the wire runs. Sometimes a mechanical device is provided for agitating the soap and ensuring its contact with the wire, but more generally such a wide variety of considerations, and it is generally left to the discretion of experienced turners to settle the amount of taper put on the blocks. The reason for putting the step in the taper is the fact that only sufficient tight turns of wire should be allowed on the block to provide the friction in the block where it first pulls on the wire, and this groove tends to prevent the turns of wire from fleeting off upwards. The block must then be turned up to a slightly smaller diameter to provide a fresh smooth surface.

When a long length of wire is being drawn a set of pegs is placed in sockets in the top of the block, so as virtually to form a continuation of its form, and provide accommodation for the turns of wire as they are pushed off the top of the block, so that as much as 2 cwt. of wire is often run off in one coil, and it is one of the arts of the wire drawer to take off a heavy coil of wire without getting it entangled or over-exerting himself.

A distinctive type of drawing machine is made by Barron and Crowther, of Preston, and is illustrated in Figs. 24 and 25. One of its peculiarities is the use of structural steel work for the framing, in the place of the usual cast iron. The arrangement has the advantages that it is comparatively light and not liable to fracture through rough usage, while the long girders at the bottom make it possible to put the machine down and set it to work without elaborate concrete foundations.

Another feature about the machine is that it is equipped with ball bearings throughout, while the main shaft runs at the comparatively high speed of 480 revolutions per minute, with a corresponding reduction in the weight on the bearings. The machine, as a fact, runs so easily that one having half a dozen blocks in one framing can be turned over easily with one hand gripping the main shaft.

The outstanding characteristic of the machine is, however, the arrangement of the drive to the block. The block is mounted loosely on a pin fixed in a

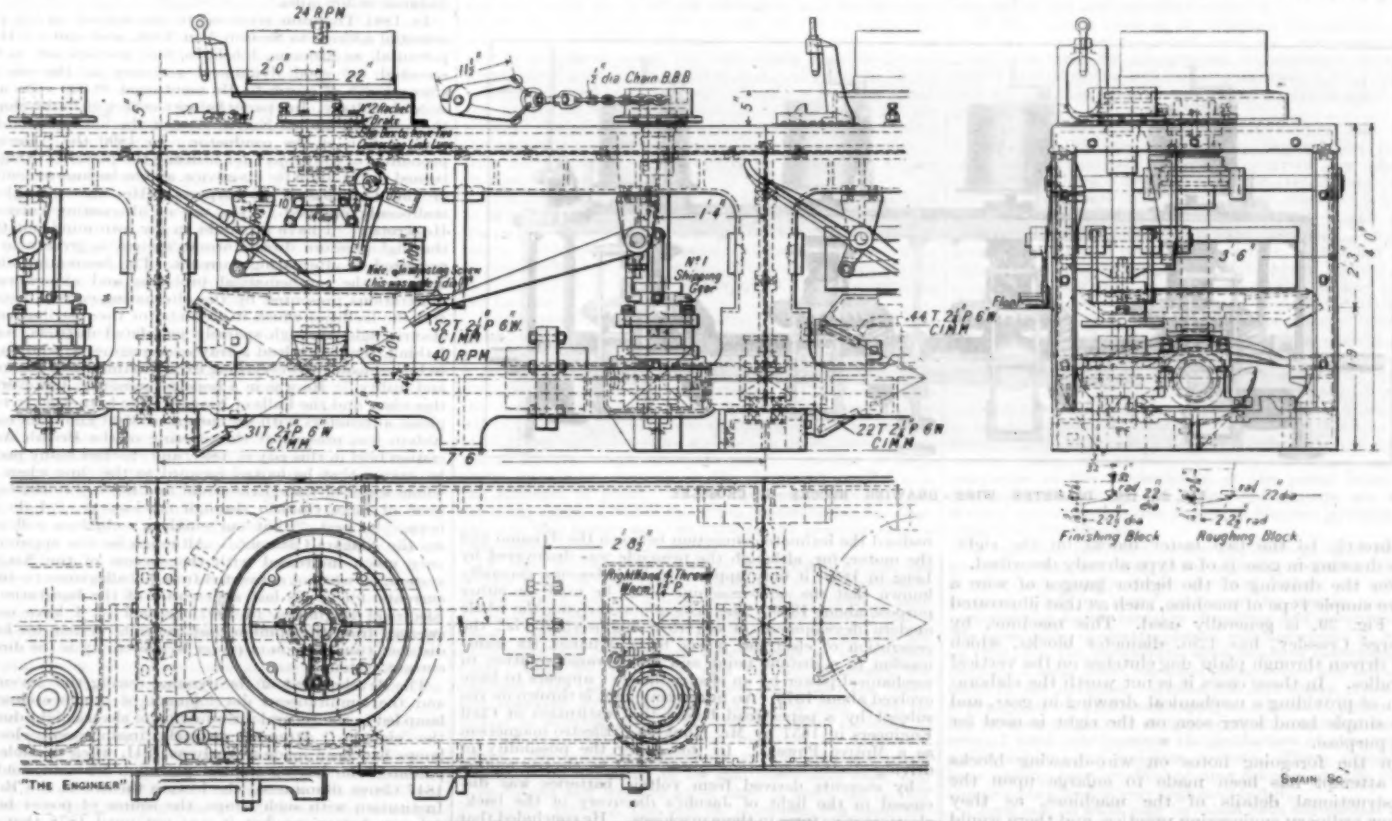


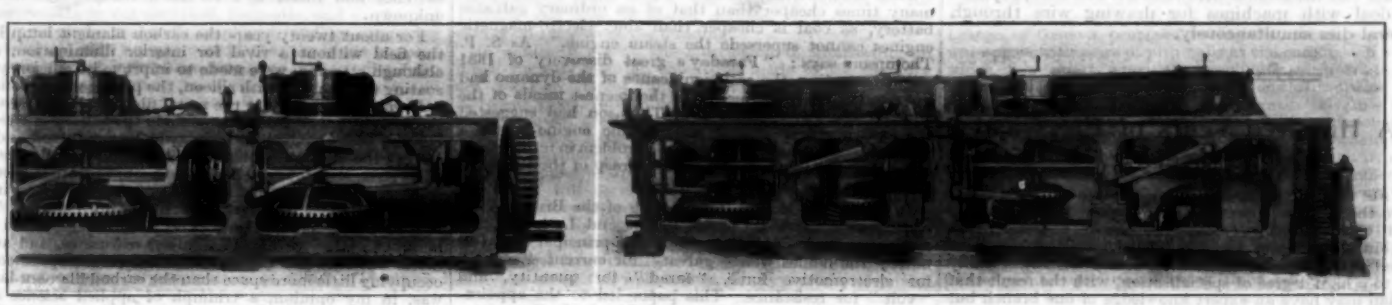

FIG. 26—7ft. 6in. HEAVY, THICK WIRE-DRAWING BLOCKS WITH CAPSTAN PULL-IN—G. CROSSLEY

this requirement is attended to by the wire drawer himself.

### Wire-drawing Blocks.

The face of a wire-drawing block, it will be noticed, is tapered upwards and has a distinct step near the bottom, for the purpose of easing off the wire upwards as it is coiled on to the drum. It does not appear that there are any set rules for determining the amount of this taper, as it is influenced by necessary for pulling it through the die, while above that limit the coil should be quite free to rise and accumulate without tending to make the new turns ride over one another.

It should be mentioned that, at starting, the end of the wire is fastened in a clamp, at the top of the block, which has a portable handle. The first turn, however, goes down to the bottom of the block and the fresh wire is always drawn on at the bottom. The result is that after long service a groove wears in the block where it first pulls on the wire, and this groove tends to prevent the turns of wire from fleeting off upwards. The block must then be turned up to a slightly smaller diameter to provide a fresh smooth surface.



FIGS. 27 AND 28 SINGLE-SIDED AND DOUBLE-SIDED WIRE-DRAWING FRAMES—G. CROSSLEY

casting on the top of the table. This casting incidentally is extended to form a fixture for the die holder. Inside the lower part of the block there is fixed an internally toothed ring, which meshes with a pinion on a vertical shaft, as shown in Fig. 24. This pinion is driven through bevel gearing and a friction clutch in the usual manner. The arrangement provides a very substantial support for the block, which will run for a long time without wearing slack, while the drive is applied, as nearly as possible,

to the point where the wire runs on to the drum. It is, of course, largely on account of the gear ratio provided by the internal drive that the speed of the main shaft can be kept up to the limit already mentioned, without the block running too fast for heavy work.

A very substantial type of block for heavy work, made by George Crossley, Limited, of Cleckheaton, is illustrated by Fig. 25. In this case the drive is transmitted through a friction clutch on the vertical spindle of the block and the machine can be started up very gently even with a heavy load on. The drawing-in gear, it will be seen, takes the form of a capstan driven through a dog clutch from worm gearing. Fig. 26 is reproduced from the general arrangement of this machine. Figs. 27 and 28 also illustrate machines made by George Crossley, and are specially interesting through indicating the economy of space which can be effected by arranging the blocks for working on alternate sides of the bench—a matter already referred to in connection with the lay-out of wire-drawing factories. These two illustrations are to the same scale, and both represent machines with blocks 22in. in diameter. It will be seen that the saving in length is in the ratio of approximately 4 to 6, while the width remains the same. Serpentine plate guards are arranged round the backs of the blocks in the case of the double-sided machine to prevent any loose end of wire flying out and hurting the man on the opposite side of the bench.

It will be noticed that in the case of the alternate sided machines—Fig. 28—the two blocks on the left have much more powerful gearing than those on the right, with the object of breaking down the heavy stuff on the first two blocks and then passing

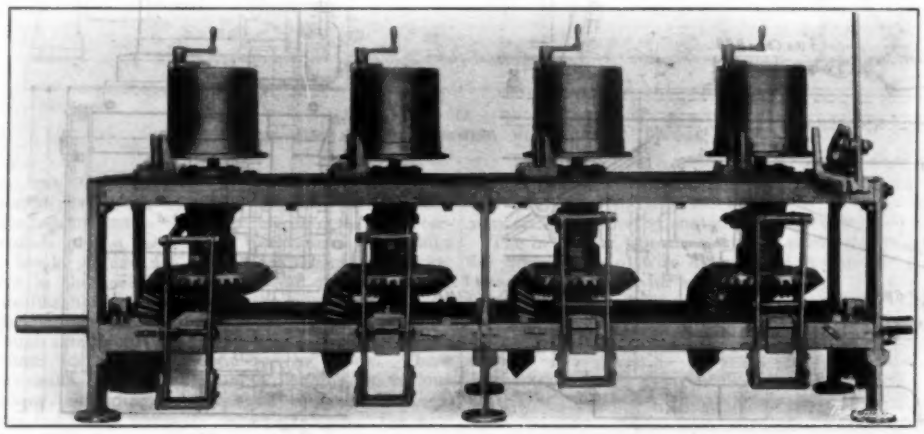


FIG. 29—12in. DIAMETER WIRE-DRAWING BLOCKS—G. CROSSLEY

it directly to the two faster blocks on the right. The drawing-in gear is of a type already described.

For the drawing of the lighter gauges of wire a more simple type of machine, such as that illustrated by Fig. 29, is generally used. This machine, by George Crossley, has 12in. diameter blocks, which are driven through plain dog clutches on the vertical spindles. In these cases it is not worth the elaboration of providing a mechanical drawing-in gear, and the simple hand lever seen on the right is used for the purpose.

In the foregoing notes on wire-drawing blocks no attempt has been made to enlarge upon the constructional details of the machines, as they follow ordinary engineering practice, and there would be no merit in explaining, for instance, that one make of machine had yellow metal bearings, while in another they were of cast iron, as such details are merely a question of price. Also there are many other British makers of wire-drawing machinery not referred to, but the examples given are sufficient to indicate the general character of this class of plant. In the next article of this series it is proposed to deal with machines for drawing wire through several dies simultaneously.

## A Hundred Years of Electrical Engineering.*

This section of the British Association, over which I have the honour to preside, is concerned with the whole field of engineering, civil, mechanical and electrical. Within recent years, the great developments which have taken place in each of these branches have necessarily led to a high degree of specialisation, with the result that a man may have an expert knowledge of one branch but a very slight knowledge of the other branches; in fact, the scope of a single branch is now so extensive and the amount of research work being done so great, that it is impossible to keep abreast of the developments in one's own special subject unless one concentrates upon it to a degree that leaves little leisure for cultivating other branches of engineering. These considerations influenced my choice of a subject for this presidential address. As an electrical engineer, I felt that I should be expected to deal with some branch of electrical engineering—indeed, I should not feel competent to discuss any other branch—but, in view of the facts to which I have referred, I decided not to deal in detail with any single section of the subject, but to review the past development and present position of the subject as a whole.

The time for such a review is opportune. William Thomson, afterwards Lord Kelvin, the only man who has ever been elected three times (in 1874, 1889, 1907) President of the Institution of Electrical Engineers, was born on June 26th, 1824. He was closely associated with the British Association and for sixty years took an important part in the meetings. He was President of the Association at the Edinburgh meeting in 1871, and was several times President of Section A. I wonder what the members of the organising committee of Section G would think if the President, in addition to reading his address, offered to contribute twelve papers to the "Proceedings" of the Section. This is what Kelvin did as President of Section A at the Glasgow meeting in 1876. I can find no record of his taking any part in the proceedings of Section G, although his brother, James Thomson, was President of the Section at the Belfast meeting in 1874.

If any one event can be regarded as the birth of electrical engineering, it is surely the discovery by Faraday in 1821 of the principle of the electro-motor; that is, that a conductor carrying a current in a magnetic field experiences a force tending to move it. It is noteworthy that ten years elapsed before Faraday discovered, in 1831, magneto-electric induction; that is, the principle of the dynamo. Four years later, Sturgeon added the commutator or "uniodirective discharger," as he called it, and in 1845 Cooke and Wheatstone used electro-magnets, which Sturgeon had discovered in 1825, instead of permanent magnets. It was during the years 1865–1873 that the shunt and series self-excited dynamo, using a ring or drum armature and a commutator of many segments, finally evolved.

The early workers in the field do not appear to have realised the intimate connection between the dynamo and the motor, for, although the principle was discovered by Lenz in 1838, it only appears to have become generally known that the same machine could be used for either purpose about 1850. The principle underlying the whole modern development of electrical engineering, viz., the generation of electrical power by a dynamo, its transmission to a distant point and its re-transformation to mechanical power by an electric motor—appears to have evolved about 1873. An interesting light is thrown on the subject by a paper read before the Institution of Civil Engineers in 1857 by Mr. Hunt on "Electro-magnetism as a Motive Power." In this paper the possibility of driving electro-magnetic engines—that is, electric motors—by currents derived from voltaic batteries was discussed in the light of Jacobi's discovery of the back-electromotive force in these machines. He concluded that power so generated would be sixty times as dear as steam power, and that it would be far more economical to burn the zinc under a boiler than to consume it in a battery for generating electro-magnetic power. The leading scientists and engineers who took part in the debate all agreed that the electromotive power was unpractical and impossible commercially. William Thomson sent a contribution in writing, which concluded with the following sentence: "Until some mode is found of producing electricity as many times cheaper than that of an ordinary galvanic battery, as coal is cheaper than zinc, electro-magnetic engines cannot supersede the steam engine." As S. P. Thompson says: "Faraday's great discovery of 1831 notwithstanding, the real significance of the dynamo had not yet (in 1857) dawned upon the keenest minds of the time." Six years before this, Thomson had suggested the experiment of driving a "galvanic engine" from a thermal battery, and had stated the problem in terms which show that he already had a correct grasp of the theory of the efficiency of the electric motor.

It was at the Manchester meeting of the British Association in 1861 that Charles Bright and Latimer Clark read a paper proposing names for the principal electrical units; the names were "galvat" for current, "ohma" for electromotive force, "farad" for quantity, and "volt" for resistance. This paper led to the appointment of the celebrated Electrical Standards Committee of the British Association, which, after six years of strenuous work, produced the system now adopted internationally.

One of the earliest applications of the dynamo was for lighting arc lamps in lighthouses. In 1863 Thomson, writing to a friend on the relative merits of the Holmes direct-current and the Nollet alternating-current lighthouse machines, says: "Thus Nollet escapes the commutator, *a great evil*, and gets a flame which does not burn one of the points faster than the other. The reverse of each proposition applies to Holmes. *The commutator is a frightful thing* . . . the thing to be done at the requisite speed is appalling. However, Holmes does it successfully. But I believe it cannot be done except theoretically without great waste of energy and consequent burning of contact surfaces. . . . *But I believe a large voltaic battery will be more economical than any electro-magnetic machine.* I am not quite confident about this, but shall be so soon, as I am getting a large voltaic, and I shall soon learn how expensive its habits are, and multiply by the number required for a lighthouse." This was thirty-two years after Faraday had discovered the principle of the dynamo.

In after years Kelvin lost his dread of the commutator and championed direct against alternating current on every possible occasion. In 1879, when giving evidence before a Select Committee of the House of Commons on Electric Light, he even assured them that there would be no danger of terrible effects from the employment of electric power, because the currents would be continuous and not alternating!

The fifteen years following 1863 saw a great development of the dynamo, and in 1878, when a paper was read before the Institution of Civil Engineers on the improvements introduced by Siemens, Thomson made a remark, following a suggestion by Dr. C. W. Siemens, that showed that he had by this time thoroughly grasped the possibilities. He said that he believed that with an exceedingly moderate amount of copper it would be possible to carry the electrical energy for one hundred or two hundred or one thousand electric lights to a distance of several hundred miles. Dr. Siemens had mentioned to him that the power of the Falls of Niagara might be transmitted electrically to a distance, and he need not point out the vast economy to be obtained by the use of such a fall as that of Niagara or the employment of waste coal at the pit's mouth. In his evidence before the Select Committee referred to above he gave an estimate of the copper required to transmit 21,000 horse-power from Niagara to a distance of 300 miles.

In 1881 Thomson returned to the subject in his presidential address to Section A at York, and said: "High potential, as Siemens, I believe, first pointed out, is the essential for good dynamical economy in the electric transmission of power." He mentioned 80,000 volts as a suitable voltage. In a paper before the Section he developed the now well-known Kelvin Law of the most economical cross-section of the conductor. In 1890 the American promoters of the project for utilising the power of Niagara turned to Thomson for his advice, and he became a member of the Commission of Experts. He was throughout stubbornly opposed to the use of alternating currents. He wrote: "I have no doubt in my own mind but that the high-pressure direct-current system is greatly to be preferred to alternating currents. The fascinating character of the mathematical problems and experimental illustrations presented by the alternating-current system and the facilities which it presents for the distribution of electric light through sparsely populated districts, have, I think, tended to lead astray even engineers, who ought to be insensible to everything except estimates of economy and utility." He was in a hopeless minority, however, in this view, and the Falls of Niagara were harnessed to two-phase alternators with an output of 3500 kilowatts each. Kelvin was present at the meeting of the British Association held in this city in 1897, and shocked many people by saying that he looked forward to the time when the whole water of Lake Erie would find its way to the lower level of Lake Ontario through machinery. "I do not hope," he said, "that our children's children will ever see the Niagara Cataract." Although he was apparently very much impressed with the success of the Niagara system, he was not converted from his allegiance to direct currents, for at his last appearance at the Institution of Electrical Engineers, in 1907, he said: "I have never swerved from the opinion that the right system for long-distance transmission of power by electricity is the direct-current system."

The development of the dynamo during the 'seventies and the simultaneous development of the incandescent lamp led to the general introduction of electric light during the 'eighties. Attempts to make incandescent electric lamps had been made as early as 1841, when de Moleyns patented one having a spiral platinum filament, and in 1847 Grove illuminated the lecture theatre of the Royal Institution with such lamps, the source of power being primary batteries; but it was not until 1878 that the commercial development of the incandescent electric lamp was begun by Edison and Swan.

One of the earliest complete house-lighting installations was put in by Kelvin in 1881. A Clerk gas engine was used to drive a Siemens dynamo, a battery of Faure cells was fitted up, and every gas light in his house and laboratory at Glasgow University was replaced by 16 candle-power Swan lamps for 85 volts. He had to design his own switches and fuses, &c., for such things were almost unknown.

For about twenty years the carbon filament lamp held the field without a rival for interior illumination, and although attempts were made to improve its efficiency by coating the filament with silicon, the plain carbon filament only gave way finally to the metal filament lamp. One of the most interesting developments in the history of electric lighting was the Nernst lamp, which was introduced in 1897; the filament consisted of a mixture of zirconia and yttria, and not only had to be heated before it became conducting, but also had to be connected in series with a ballast resistance in order that it might burn stably. The way in which these difficulties were surmounted and the lamp, complete with heater, ballast resistance, and automatic cut-out, put on the market in a compact form, occupying little more space than the carbon filament lamp, was, in my opinion, a triumph of applied science and industrial research. The efficiency was about double that of the carbon lamp. About this time, however, a return was made to the long-neglected metal filament. The osmium lamp invented by Welsbach in 1898 was put on the market in 1902, to be followed two years later by the tantalum and tungsten lamps. The latter was greatly improved by the discovery in 1909 of the method of producing ductile tungsten and by the subsequent development of gas-filled lamps in which the filament can be run

* British Association's Toronto Meeting: Address by Professor G. W. O. Howe, D.Sc., President, Section G.

at such a temperature without undue volatilisation that the consumption is reduced in the larger sizes to 0.6 watt per mean spherical candle-power. This improvement of eight times as compared with the efficiency of the carbon filament lamp has led to the gradual replacement of the arc lamp even for outdoor illumination. The arc lamp was introduced at about the same time as the carbon filament lamp, the Avenue de l'Opéra having been lit with Jablochkoff candles in 1878. The open arc was developed during the 'eighties; the enclosed arc, giving long burning hours and thus reducing the cost of re-carboning, was introduced in 1893, and the flame arc in 1899. During the first few years of this century the flame arc was brought to a high state of development and the consumption brought down to about 0.25 watt per candle-power, but the necessity of frequent cleaning to prevent the reduction of efficiency by dirt and the labour of re-carboning have led to its abandonment in favour of the less efficient filament lamp.

Before leaving the subject of electric lighting I would point out that it is remarkable that the first great application of electric power should have been for the production of electric light, since it is probably the least efficient of all its applications. The overall efficiency of a small power station supplying a lighting load and having therefore a very poor load factor would not be greater than about 6 per cent. from coal to switchboard, the steam engine being, of course, the principal offender. Of the total power supplied to and radiated from a carbon filament lamp not more than about 2 per cent. was radiated as light, so that the overall efficiency from coal to light was 2 per cent. of 6 per cent., which means that of every ton of coal burned at the power station with the object of producing light, all but about 3 lb. was lost as heat at various stages of the transformation. Even now, with up-to-date steam plant and gas-filled lamps, the overall efficiency from coal to light is not equivalent to more than 40 lb. to 60 lb. of coal out of each ton. The electrical engineer may derive a little comfort from the knowledge that the purely electrical links are the most efficient in the chain.

Whilst on the subject of efficiency I might point out that the difference between the prices at which coal and electrical energy can be purchased by the ordinary citizen corresponds to the losses incurred in the power station; that is to say, that the cost of the generation and distribution of the electrical energy is covered by the better terms on which the power station can obtain fuel. In Glasgow the writer pays £5 per ton for anthracite to burn in a slow combustion stove; taking the calorific value of anthracite at 9000 kilowatt-hours per ton, which is equivalent to 14,000 British thermal units per pound, this works out at 7¼ kilowatt-hours for a penny. For electrical energy for heating and cooking purposes the writer pays a penny per kilowatt-hour. This ratio of 1 to 7¼ will correspond fairly closely to the overall efficiency of the power station. In view of the high efficiency and convenience of slow combustion stoves, it is evident that electric heating cannot be expected to compete with them for continuous operation; for intermittent heating the question is very different.

Returning from this digression to the development of the direct-current dynamo, it may be noted that the drum armature now almost exclusively employed was invented in 1872 by von Hefner Alteneck, and gradually displaced the ring armature of Pacinotti and Gramme. Although Pacinotti's original ring armature was slotted, smooth armatures were preferred for many years, until the mechanical superiority of the slotted armature caused the disappearance of the smooth core with its wooden driving pegs which were employed to transmit the turning moment from the conductors to the core. The commutator and brushes were a great source of trouble, but by the gradual elimination of unsuitable material and by better design and methods of manufacture the commutator has been made a most reliable piece of apparatus. The difficulties of commutation, and especially the need of continual adjustment of the brush position, were largely overcome by the invention of the carbon brush by Professor George Forbes in 1885. It should be pointed out that the commutating poles, which have come into use so much in recent years, were originally suggested in 1884, and are therefore older than the carbon brush.

The realisation of the idea of supplying electric current from a power station for lighting houses in the neighbourhood owed much to the energy and business ability of Mr. Edison. He exhibited his first "Jumbo" steam-driven dynamo in 1881, and installed two sets at Holborn Viaduct in the following year to supply current to neighbouring premises. The output of these sets was about 90 kilowatts at 110 volts, which was so much larger than anything previously constructed that the name "Jumbo" was applied to these sets. About 1890 the multipolar type began to replace the bipolar type for the larger sizes. The size of the single units employed in power stations gradually increased with the increasing demand, and by 1895 dynamos of 1500 kilowatts had been installed.

As in all other types of machinery, the output obtainable from a given size has been gradually increased by improvements in the electrical, magnetic, and mechanical properties of the materials employed, and by improving the design so as to remove ever further the limits imposed by heating, sparking, voltage drop, &c. The freedom from trouble of the enormous number of electric trams and trains, to take only one class, is a testimonial to the reliability of the modern direct-current motor.

The alternator has had a more varied development than the dynamo, mainly because of the absence of the commutator. The necessity of keeping the brush gear stationary and accessible and therefore allowing the commutator and armature to rotate led to an early standardisation of type in the direct-current machine. In the alternator there was no such limitation, and whether the field system should be inside or outside the armature and which of the two should rotate were largely matters of choice. There are great advantages in having the armature, which usually carries a high-voltage winding, stationary, and the usual practice has been for the field system to rotate within the armature. The most striking and best-known exception is the umbrella type of alternator installed in the first Niagara power station, in which the field system rotates outside the armature. The design of alternators has been controlled to a large extent by the development of the prime mover. On the Continent of Europe the slow-speed horizontal steam engine led to the construction of alternators of enormous diameter in order to get the necessary peripheral speed, the axial length being consequently reduced to a few inches. In several cases these machines reached such a height that the travelling cranes in the erecting shops were useless, and special tackle had to be erected in order to assemble the machines. In England the high-speed marine type engine was generally preferred, and consequently the alternators had a smaller number of poles and a smaller diameter. All this has now been modified by the development of the steam turbine.

Ferranti was apparently the first to suggest that the power station should be outside the city, at a point convenient for fuel and water supply, and that the power should be transmitted into the city by high-voltage alternating currents. In 1890 he built the Deptford station for the London Electric Supply Company and installed 1000-kilowatt 10,000-volt alternators. This was the pioneer high-voltage underground cable transmission, and much was learnt concerning the peculiarities of alternating currents when transmitted over cables of considerable capacity. The following year, 1891, saw the first long-distance transmission by means of overhead conductors in connection with the electrical exhibition at Frankfort-on-Main; three-phase power was transmitted at 8500 volts, from a water power station at Lauffen to Frankfort, a distance of 110 miles.

This development of the use of high-voltage alternating currents followed the development of the transformer. Gaulard and Gibbs patented a system of distribution involving transformers in 1882, and, although their patent was upset in 1888 on the ground of its impracticability, the present method of using transformers for the distribution of electrical power was introduced in 1885, and shown at the Inventions Exhibition in London in that year. Although from 1890 onwards there has been a steady increase in the size of alternators and transformers and in the voltage employed for long distance transmission, the last few years have seen a really amazing increase in the size of the units employed. In 1913 the largest 2-pole turbo-alternators had an output at 3000 revolutions per minute of about 7500 kilowatts; such machines are now made up to 30,000 kilowatts, and 4-pole alternators are running at 1500 revolutions per minute, with an output of 60,000 kilowatts. This increase in size and in peripheral speed has been made possible by improvements, both in the material and in the design. With a bursting speed of 25 per cent. above the running speed, the peripheral speed can now be raised to 150 m. per second. Improved methods of cooling and a better understanding of the various causes of loss in the armature have enabled the materials to be used at higher current and flux densities.

This great increase in the size of units is not confined to the steam turbo-generator, as can be seen from the water-turbine sets recently added to the Niagara installation. Whereas the original Niagara turbines were of about 5000 horse-power, the new ones have an output of 70,000 horse-power at the low speed of 107 revolutions per minute.

The importance of cheap electric power has led to this great increase in the size of the units in the generating stations. Any slight difference of efficiency between a 10,000-kilowatt and a 60,000-kilowatt alternator is of little importance, and would certainly not counterbalance the decreased factor of safety due to concentrating the whole power supply in three or four large units, instead of distributing it between a dozen or more units. The reason for the adoption of the smaller number of large units lies almost entirely in the decreased capital cost per kilowatt of plant. In my opinion, however, there are many cases in which too much consideration has been given to this factor, and too little to the importance of a guaranteed continuity of supply.

Of even greater interest than the growth in the size of the units in the power station is the development of the switch control and protective gear, which is such an essential element in the success of the modern power plant. In the early days of electrical supply all the switchgear was mounted on slate panels in the engine-room; then, as the power and voltage increased, the switches were placed above, below, or behind the board and operated by mechanical links; then they were removed to another part of the building, each enclosed in its own fire-proof cubicle, and operated by means of relays. The modern high-power switch, like the transformer, is oil-immersed in its iron containing case, and is so robust and weather-proof that it needs no further protective covering, but can be placed in the open air. The insulated bushings through which the leads are taken into the case are the most vulnerable points, but constitute no insuperable difficulty at the present time.

The development of these robust and weather-proof switches and transformers has led to the introduction of the open-air sub-station in cases where alternating current has to be transformed from one voltage to the other, and there is consequently no running machinery. In generating stations also much of the controlling and transforming plant which was formerly housed in the building can now be placed outside, with considerable saving on the cost of the building.

In connection with the conversion of alternating to direct-current, mention should be made of the mercury arc rectifier. Great improvements have been made in recent years, especially in Switzerland, and a number of high-power arcs have been installed in sub-stations. Although they have the advantage of doing away with running machinery, the modern rotary converter is such a reliable piece of apparatus that it is very questionable whether it will be replaced to any considerable extent by the mercury-arc rectifier.

Until recently the only means of producing a large amount of high-voltage direct-current power was by connecting a large number of carefully-insulated dynamos in series, as in the well known Thury system of power transmission. Within the last two or three years another method has been developed, viz., the so-called transverter, which consists of an arrangement of transformers and a system of rotating brushes, whereby a three-phase alternating-current supply is converted into an almost steady continuous current. The first apparatus of this type to be exhibited is installed at the British Empire Exhibition at Wembley, and is designed to deliver continuous current at 100,000 volts. It can also be used for the reverse process. It would thus enable a three-phase generating station and a three-phase sub-station to be connected by a direct-current transmission line, thus avoiding not only the maximum voltage of 1.4 times the effective voltage, which was one of Lord Kelvin's objections to the alternating-current system, but also all trouble due to the capacity and inductance of the line. Whether the disadvantages of the transverter, when it is fully developed—it is yet in its infancy—will more than outweigh these advantages remains to be seen, but, apart from the transmission of power, the device may have many applications.

Electric traction represents one of the most important branches of electrical engineering. It shares with the petrol motor the distinction of having absolutely revolutionised the methods of transport within a single generation. In its origins it is nearly a century old, for attempts were made in the thirties to apply Faraday's newly discovered principle to the propulsion of vehicles, but, with very primitive motors and primary batteries, these attempts were doomed to failure. The development of the dynamo and motor in the seventies opened the way to further experiments, and at the Berlin Exhibition in 1879 a line one-third of a mile long was shown in operation, a locomotive drawing three cars. The first regular line was opened to traffic near Berlin in 1881; it worked at 100 volts and the current was collected from an insulated rail. Toronto was the scene of one of the earliest experiments in America; C. J. van Depoele, after some experiments in Chicago in 1882 and 1883, ran an electric locomotive in 1884 between the street-car system and the Exhibition in Toronto.

The difficulties were enormous. The carbon brush was not invented until 1885, and commutation in a reversible motor with copper brushes caused great trouble; armature construction and winding was in its infancy; the suspension of the motor and the method of gearing it to the car axles were problems which were solved only after much experience. Rapid progress was made after about 1887, and the closing years of the century saw an enormous development, the elimination of horse tram-cars throughout the world and the electrification of a number of city and suburban railways.

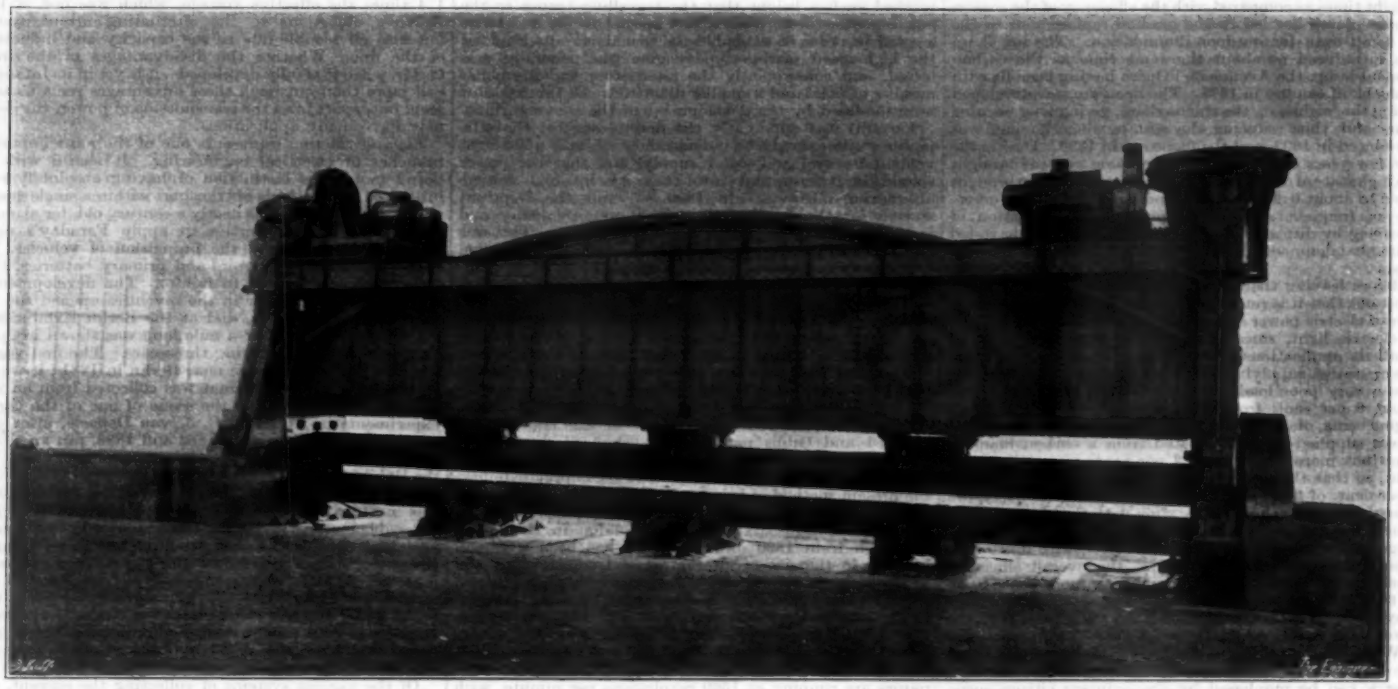
Of the various systems of collecting the current, only two have survived for street cars, viz., the usual overhead wire and the exceptional underground conduit; in the case of railways there is no necessity for a conduit, and the conductor rail is carried on insulators above the ground level.

Although 500-volt direct-current supply has been standardised for street tramways, the relative merits of direct-current and alternating-current for electric railways has been a burning topic for over twenty years, and is now perhaps more burning than ever. It is somewhat akin to the battle of the gauges in the early days of steam railways, for it involves in many cases the problem of through running, if not now, in the not very distant future. Although the three-phase system was successfully installed in Northern Italy, it has grave disadvantages, and the battle now is confined between direct-current at an increased voltage of, say, 1500 to 2000 volts, and single-phase alternating-current. In the latter case there is, moreover, a further question as to the best frequency to adopt, this being usually either 25 or 16⅔. The development of the alternating-current commutator motor to the stage where it was applicable to traction took place during the first few years of this century, and, although in itself it is inferior to the direct-current motor, it introduces so many simplifications and economies in the transmission of the power from the generating station to the train that experts are very divided as to the relative merits of the two systems for main line electrification.

I can only just refer to the applications of electrical power to chemical and metallurgical processes. Some of these are purely electro-chemical, others are purely thermal, while in many processes the electric current performs the double function of melting and electrolysing. The possibility of electro-plating was discovered as early as 1805, but the commercial application of electro-chemistry on a large scale was impossible before the development of the dynamo. Within the last thirty years the provision of an abundant supply of electrical power has led to the creation of enormous electro-chemical industries; I need only instance the production of aluminium, carborundum, and calcium carbide. These industries have usually been established near a hydro-electric plant and provide a load of very high load factor.

I turn now to what may be called both the earliest and the latest application of electricity; that is, its use for transmitting intelligence. One of the greatest factors in the development of our modern life has undoubtedly been the network of wires and cables which has spread over the whole earth, making possible an almost instantaneous transmission of intelligence and interchange of opinions. In the early days of electrical science the discovery of a new property of electricity was followed by attempts to utilise it for this purpose. As early as 1746 there are records of the use of frictional electricity for the purpose, and distances up to 4 miles were tried. In 1774 Lesage, of Geneva, proposed twenty-six wires in earthenware pipes with pairs of pith-balls at the end of each wire, which flew apart when the conductor of a frictional machine was brought near the other end of the wire. A current of electricity was unknown until Galvani's discovery in 1789, and Volta's pile was first constructed in 1792. Carlisle in 1800 found that water was decomposed by passing the current from a Volta pile through it, and this was the basis of the telegraph proposed by Sömmering in 1809, in which twenty-six wires ended in twenty-six metallic points arranged in a row along the bottom of a kind of aquarium. By means of a lettered keyboard at the sending end the current could be applied to any wire, and a stream of bubbles caused to rise from the appropriate point, each point being duly labelled with its appropriate letter. The magnetic effect of the electric current was discovered in 1819, and immediately replaced the previous methods in efforts to develop an electric telegraph; except for the attempts to make a high-speed chemical telegraph, all subsequent telegraph systems have employed the magnetic effect of the current. A great many of the fundamental inventions of telegraphy were made in the 'thirties; the list includes the needle instrument of Cooke and Wheatstone, the sounder of Henry, the dot-and-dash inker of Morse, and the use of the earth as a return

# LARGE PLATE-BENDING ROLLS AT SWANSEA



by Steinheil. Although the needle instrument is now obsolete, the sounder and Morse inker are still commonly employed. Many have been the devices for increasing the amount of traffic which can be worked over a single line, either by the simultaneous use of the line by a number of operators, as in the quadruplex and multiplex systems, or by punching the messages on paper tapes, which can then be fed into an automatic transmitter working at a speed ten to twenty times that attainable by a manual operator. In the most up-to-date systems the perforation of the tape is done by the operators working an ordinary typewriter keyboard, and the received message is printed in ordinary type, a single wire carrying eight messages simultaneously, four in either direction, at a speed of forty words per minute.

The need for telegraphic communication between countries separated by water was so much the greater because of the slowness of other means of communication, but the difficulties in laying and maintaining 2000 miles of insulated wire on the bottom of the sea must have appeared almost insuperable to the early workers; fortunately, however, there were men who had the necessary vision and courage. The flimsiness of the early cables suggests that the pioneers under-estimated the magnitude of the problem which faced them, which was perhaps fortunate. A cable was laid between Dover and Calais in 1850; it lived only a single day, but it was replaced in the following year by a successful cable.

The first cable was laid across the Atlantic in 1858, and, although in the light of our present knowledge we know that it could not have had a very long life, its failure after a few weeks of preliminary communication was primarily due to misuse owing to the ignorance of those in charge. Although much costly experience had been gained in the laying of cables in various parts of the world since this first attempt to span the Atlantic, the success of the second Atlantic cable in 1866 was largely due to the scientific ability of Kelvin and to his enthusiastic and untiring application to the project at every stage of the manufacture and laying of the cable. In addition to this, he not only designed the receiving instruments, but superintended their manufacture in Glasgow and their installation and operation. The success of the Atlantic cable was to a large extent a personal triumph for Lord Kelvin. Although numerous improvements have been made in the details of cable manufacture and in the transmitting and receiving apparatus, no outstanding change has been made in recent years in the methods of submarine telegraphy.

Turning to another branch of electrical communication, it is no exaggeration to say that modern business life has been revolutionised by the telephone, which will shortly celebrate its jubilee, for it was in 1876 that Graham Bell invented the magnetic telephone receiver, although others, notably Reis, had been working at the problem since 1861. Bell showed his telephone in operation at the Philadelphia Centennial Exhibition in 1876, and Kelvin, who was one of the judges, brought one back with him and demonstrated it to Section A of the British Association, at its meeting in Glasgow in the autumn of 1876.

A successful telephone system requires much more than efficient transmitters and receivers, and the great development which has taken place has been largely a matter of improvement in the design of the many elements that go to make up a telephone exchange. The modern manual central battery exchange, in which one has only to lift his receiver to call the operator and be connected in a few seconds to any one of 10,000 other subscribers, is a marvel of ingenuity and construction. But this is now gradually being replaced by the greater marvel of the automatic system, in which the operator is eliminated and the subscriber automatically makes his own connection to the desired subscriber. Attention should be drawn to two outstanding inventions in the actual transmission of telephony over long distances, viz., loading and repeaters. It was Oliver Heaviside who in 1885 proposed to improve the range by increasing the inductance of the line. Although this revolutionary suggestion fell on deaf ears for fifteen years, it ultimately proved to be one of the great inventions of telephony; it is of special importance in underground and submarine telephone cables, the electrostatic capacity of which otherwise seriously limits the range. The other outstanding novelty is the introduction of repeaters at intermediate points in long telephone lines. These repeaters are specialised types of low-frequency amplifiers; they were made commercially possible by the invention and perfection of the three-electrode thermionic valve. The attenuated speech currents arriving at the end of a section of line are amplified and thus given a new lease of life before being passed on to the new section. By using a large number of such repeating stations telephonic communication has been established between New York and San Francisco. But in addition to making such long-distance communication possible, the use of repeaters enables medium distances to be bridged by relatively cheap lines of high attenuation.

One important application of telephony which is not generally known is in the control of transport; the advantage to be gained by controlling the whole railway traffic of a large district from a central office need only be mentioned to be appreciated.

Turning now to radio telegraphy and telephony, one cannot but marvel at the rapidity of its development and the inroad that it has made during the last two or three years on the domestic life of the whole civilised world. The theory of Clerk Maxwell in 1864 and the laboratory experiments of Hertz in 1888 found their first practical application in Marconi's Italian experiments in 1895 and his demonstrations in England during the following year. Much of the rapid progress was due to his perseverance, vision, and courage in perfecting apparatus for short-distance work, and simultaneously experimenting over long distances, and thus, in the year 1901, settling by actual demonstration across the Atlantic the vexed question as to whether the waves would pass around the earth over distances of several thousand kilometres or go off into space.

The accomplishment of long-distance communication bristled with difficulties, largely due to unsuspected atmospheric effects which are still little understood; but such progress has been made and is continually being made that one dare not now adopt an incredulous attitude to the wildest dreams or forecasts of what is to be accomplished by "wireless." The commonplace facts of to-day would have appeared beyond the bounds of possibility ten or twenty years ago.

I have attempted to trace, in a necessarily somewhat superficial, but, I trust, none the less interesting, manner the development during the last hundred years of some of the principal applications of electricity to the service of mankind. In preparing this address I have been greatly impressed by the enormous advances made, especially during the last thirty or forty years, in the mastery of man over the resources of Nature, and in the use of these resources to the amelioration of the conditions of life. By the aid of electricity the energy of the coal or of the lake or river a hundred or even two hundred miles away is transmitted noiselessly and invisibly to the city, to supply light and warmth, to cook the food, to drive the machinery, to operate the street cars and railways.

By its aid one can flash intelligence to the most distant part of the globe, hold conversations with friends hundreds or even thousands of miles away, or sit in one's home and listen to music and lectures broadcast for the entertainment or instruction of all who care to equip themselves with what may almost be regarded as a new sense. Whereas thirty years ago a ship at sea was completely isolated from the life and thought of the world, it is now in continuous communication with the land and with every other ship within a wide range.

In no branch of electrical engineering, however, is there any suggestion of having reached finality; on the contrary, rapid development is taking place in every direction, and we can look forward with confidence to an ever-increasing application of electricity to the utilisation and distribution of the natural sources of energy for the benefit of mankind.

## Large Plate-bending Rolls.

In the article describing the machinery at the dry dock and ship-repairing works of Palmers (Swansea) Dry Dock Company, Limited, which appeared in our issue of May 23rd last, we mentioned the fact that in the plate shop there was a fine set of plate-bending rolls made by Hugh Smith, Limited, of Glasgow. We are now enabled to illustrate this excellent machine in the accompanying engravings, of which that at the head of the page has been reproduced from a photograph taken of it in position, while the outline drawing is given to show the portions of it which come below the floor line.

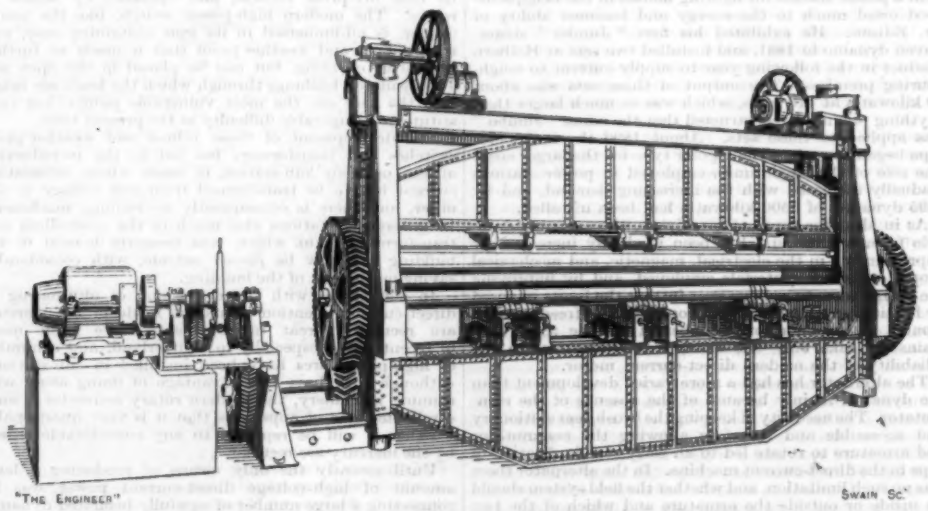



PLATE-BENDING ROLLS, SHOWING PORTION BELOW FLOOR LEVEL

There are one upper and two under rolls, all of them of forged steel. They are stiffened by heavy steel girders top and bottom with three sets of forged steel supporting rollers to distribute the stresses, and to provide adequate bearing surface. The distance between the two under rolls is adjustable, the rolls being brought close together when thin plates are being bent, and set further apart when thick plates are being dealt with. The top roll can be raised and lowered independently at each end by means of steel screws and bronze nuts, the latter being rotated by worms, worm wheels and spur grears, the power being supplied by two 25 horse-power reversing electric motors, one at each end, furnished with brakes for quick stopping. The machine can bend plates up to 40ft. long and 2in. thick.

The two under rolls are driven through large helical steel wheels and pinions, at opposite ends of the machine, by a heavy shaft which runs below them and between the two under supporting girders. The shaft itself is driven through a train of gearing by a 180 brake horse-power reversing motor, which is fitted with a magnetic brake for quick stopping. The gear provides two speed ratios—a quick speed for light work and a slow speed for heavy plates.

For the sake of rigidity, the housings are built up of cast iron, but the main stresses are taken by four large steel bolts, which pass from top to bottom through the housings.

## New Mining Methods on the Rand.

During the last couple of years improved mining methods on the Rand gold mines have reduced the working costs by amounts which in some instances amounted to 7s. per ton of rock milled. In some mines this reduction in costs has meant the difference between profit and loss, between carrying on and closing down; in all cases it has been a welcome counterbalance to the reduction which has taken place in the value of gold, or, rather, in the amount of the gold premium.

The factors which have been responsible for the fall in working costs are:—(1) Increased efficiency of white and coloured employees; (2) a progressive reduction in the cost of breaking rock in the stopes. For years close study has been given to the important subject of rock breaking underground, including the treatment of drill steel, the testing of drilling machines, the economical use of compressed air and explosives, and so forth. The stable industrial conditions prevailing of late have enabled the results of these investigations to be translated into practice. The chief outcome of the researches has been the replacement of hand drilling and the heavier types of drilling machines by jack-hammer machines.

The great progress made in the efficiency of machine stoping at the Crown Mines is demonstrated by the following:—

| | January, 1923. | | April, 1924. |
|---|---|---|---|
| Total fathoms broken by machines | 11,281 | .. | 12,849 |
| Fathoms broken by jack-hammers | 2,691 | .. | 11,650 |
| Percentage of total .. .. .. | 23 | .. | 89 |
| Cost per fathom— | | | |
| Jack-hammers .. .. .. .. | 58s. 2d. | .. | 40s. 4d. |
| All machines .. .. .. .. | 71s. 1d. | .. | 42s. 10d. |
| Fathoms per jack-hammer shift | 0.68 | .. | 1.64 |
| Fathoms per machine shift, all machines .. .. .. .. | .68 | .. | 1.49 |

The extended use of jack-hammers at the same mines has made it possible to reduce the average stoping width from 54.7in. in January, 1923, to 49.6in. in April, 1924, and the gold contents of the reef are now being extracted with a less tonnage mined per fathom, and with consequent saving in the transport charges and cost of treatment per fathom mined.

But beyond this there have been improvements which, while not reducing very materially the working costs, has improved the recovery, and in other ways increased the working revenue. For instance, the introduction of Corduroy concentration in place of amalgamating tables has been responsible for a large increase in recovery. At Crown Mines, where it has been adopted, the recovery in the first four months of the year was 2s. per ton higher than in the corresponding period of the previous year, while costs were 7d. less.

During the past year the all-sliming process has been adopted at a couple of mines. One of them is the West Springs, which has only just started producing, and there, by the employment of the all-sliming plant, the company has already demonstrated the truth of one of the claims made for the process, namely, a considerable saving in capital outlay. The further benefits which the company confidently expects are:—(1) Low working costs; (2) small residues; and (3) elimination of gold thefts.

Another new invention, of which great things are expected, has been installed at the West Springs. Sir Ernest Oppenheimer, at the recent meeting of the company, said that it was expected that the capacity of the plant, which was designed for 40,000 tons a month, would probably be 50,000 tons, owing to the use of a new type of corrugated tube-mill liner. This liner, it is now an open secret, has been giving remarkable results at New State Areas. That company's all-sliming plant was designed to deal with 50,000 tons a month, but in April it treated 59,000 tons, and the figure now being attained is likely to be in the region, if it does not exceed, of 70,000 tons. Even that does not represent the maximum, as further tonnage output may be secured at a comparatively slight expense. An engineering firm at Krugersdorp, it may be mentioned, is experimenting with yet another form of tube-mill liner, which is described as being of the rifled type.

In a message to the staff of the Southern Railway, Sir Herbert Walker, the general manager, after expressing approval of the fact that the whole of the employees are applying themselves with energy to the important questions which have risen consequent upon amalgamation and are loyally supporting their officers in the carrying out of the tasks which have developed upon them, said that "It would appear that the fall in revenue has now been arrested."

## Provincial Letters.

### THE MIDLANDS AND STAFFORDSHIRE.

*(From our own Correspondent.)*

**The Summer Vacation.**

The attendance at the weekly meeting of the Midland iron and steel trade at Birmingham to-day (Thursday) was very small. Most works in this area are closed down for the whole of the week, and producers and consumers alike have not yet returned from their sea or country holiday. The amount of business transacted was of little moment. Industrialists were more concerned with discussing future prospects than immediate contracts, and it must be confessed most of them were none too optimistic. Some branches of engineering show improvement, but business is irregular when taken on the whole, and it is exceedingly difficult to arrive at any satisfactory conclusion as to the trend of future trade. The recently announced intentions of the Government were considered favourably as a means of assisting the iron and steel and engineering industries to carry on.

**Projected Electrical Power Developments.**

The financial assistance promised by the Government to enable greater co-ordination in the supply of electricity was received with much pleasure in the Midlands, where a scheme of co-ordination is already in operation, though it has been curbed by financial and other restrictions. The assistance now promised by the Government will, it is hoped, lead to more rapid developments in the future. Considerable progress on a co-ordinated basis has already been made for the electrical development of the South-West Midlands, in which Birmingham is situate. A definite responsibility for the electrical development in the various areas has been placed upon the Corporation of Birmingham, the Shropshire, Worcestershire and Staffordshire Electric Power Company, and the Leicestershire and Warwickshire Power Company. A joint advisory committee has been appointed by the Birmingham Corporation and the Shropshire Company, and its function is to see that the district comprising the South-West Midlands is adequately supplied with electric current. Efforts are being made throughout the area to institute a uniform periodicity without which interchanges between one station and another are difficult. A big generating station is being built by the Shropshire Company at Stourport, while Birmingham has a scheme for a new station on the Hams Hall estate. The Birmingham supply is to be linked up with that of the Shropshire Company at Halesowen, fed from Stourport, so that if need arises current from Birmingham may be taken by the latter for the supply of its huge area, and, on the other hand, similar assistance may be extended by the company to Birmingham. Extensions are to take place at Smethwick and Worcester. The co-ordination scheme, as a whole, is designed to ensure not only economical production of current, but the ultimate linking up of all localities in the South-West Midlands.

**Birmingham to the Sea.**

I have referred on many occasions in my letters to The Engineer to the question of improving transport facilities between Birmingham and the sea, and have from time to time written of the efforts being made to improve the canal system, so as to permit of 100-ton barges coming direct from the coast to Birmingham and other Black Country towns, without reloading. Industrialists in this area who believe such a system would aid the industries of the district are accordingly considerably pleased with and interested by the statement of the Chancellor of the Exchequer in the House of Commons that the Government would welcome the continuance of inquiry and negotiations in connection with the canal development scheme for Birmingham and the Midlands, which have been going on for a long time, but as yet with no result. Mr. George Fisher, the secretary for the National Council of Inland Waterways, expressed the view that the efforts of the Council are about to bear fruit. Keen-sighted business men hereabouts, who have always had faith in the practical utility of an improved internal waterway system, are pleased to learn that the Government favourably regards the consideration of plans for the improvement of the waterways between Birmingham and the sea. They trust that the past neglect of canals is about to be remedied.

**Black Country Works to Reopen.**

I learn that Roberts and Cooper, Limited, which recently ordered a complete stoppage of several of its establishments, has decided to reopen its Bromley and Brettell-lane departments on August 18th, and that the necessary preparations are being made. The works, which comprise four mills, produce several descriptions of finished iron and steel, and the two works will find employment for about 200 men.

**Steel Works Strike.**

The Spring Vale Steel Works of Alfred Hickman, Limited, Bilston, remain closed so far as productive work is concerned, and the interim is being filled up by loading and straightening out the material on hand. Some of the strikers are stated to be willing to resume work. Nothing has been decided as to when the furnaces will be restarted, but it will not be before the middle of the month.

**Indian Contract for Birmingham Firm.**

Considerable satisfaction is expressed that in face of intense competition the Metropolitan Carriage and Wagon Company, of Birmingham, has secured an important Indian railway contract. The order, which is for the Madras and Southern Mahratta Railway Company, comprises the supply of 200 wagons, 100 covered goods wagons and 100 open goods wagons, all of the broad-gauge type.

**Finished Iron.**

Business is still slow in the Staffordshire iron trade, though the makers of marked bars are able to sell their output on the £15 basis. The wage increase is expected to make prices firmer, although the manufacturers have not yet seen their way to increase the price of medium bars from £13 to £13 10s., a step taken by South Yorkshire three weeks ago. Lancashire also retains the £13 figure. Some very cheap continental iron is on offer, No. 3 Belgian bars for nut and bolt-making being quoted at £8 delivered, as against the local price of £12. In neither Crown bars nor common qualities is there any activity, nor is the outlook regarded as alluring.

**Galvanised Sheets.**

The galvanised sheet trade is brisk with excellent order books on the £18 5s. basis for 24 gauge galvanised corrugateds. The demand for thin gauges is especially active, work being assured for some months to come. The mills are receiving a steady, if not a large flow of new orders.

**Midland Ironworkers' Wages Advanced.**

The bi-monthly return of selling prices of finished iron for May and June, under the Midland Iron and Steel Wages Board, shows an advance sufficient for an increase in the wages of ironworkers of 2½ per cent. for the two months commencing August 11th. This increase, following upon advances of 2½ per cent. in June and 5 per cent. in April, brings puddlers' wages up to 65 per cent. above the basis rate of 13s. 6d.

**Steel.**

The steel trade remains far from bright. Structural steel business is remarkably slow, but it is believed that with reasonably stable prices, a good deal of new work would be given out. The £10 quotation for small bars is cut, probably to the extent of 5s. per ton. Belgian bars are again cheaper, on the basis of £6 7s. 6d. Antwerp, or about £7 12s. 6d. here. Steel makers are not disposed to make further concessions in price, £7 10s. being considered the irreducible minimum for billets and £9 10s. in the minimum acceptable for joists. These prices, however, are being severely undercut by Belgium, who is quoting £6 10s. delivered in the Black Country for billets, with joists £5 18s. 9d. Antwerp, equivalent to £7 2s. 6d. delivered in the district, against the native price of £9 10s. to £9 15s.

**Pig Iron.**

The pig iron department continues sluggish, with insufficient orders to absorb the output from the furnaces. Prices, which are slightly weaker, are unremunerative. For Derbyshire No. 3 foundry iron £4 7s. 6d. remains about the market level, while Northamptonshire makes round about £4 2s. 6d. per ton at furnaces. There is practically no call for forge iron, a sufficient index of the state of the South Staffordshire iron trades.

**Scrap.**

Scrap is a weak market, and values are falling. On 'Change in Birmingham to-day, £4 15s. was quoted for wrought iron scrap, £3 10s. for steel turnings and £4 for heavy steel scrap, all delivered. Some significance was attached to the decision of a number of the steel works to retain their steel scrap for melting purposes, instead of offering it on the market.

**Cannock Chase Miners' Wages.**

The ascertainment of wages, under the national agreement, for the miners in the Cannock Chase area for the month of August, shows a reduction of 11.46 per cent. compared with July. This is equivalent to a drop of 9d. per day on the minimum wage of stallmen, who will now receive 11s. 1d. per shift, as against 11s. 10d. for July. Other grades of mine workers suffer reductions in proportion, the decreases ranging from 1s. per day in the case of firemen to 3d. per day for youths. The new ascertainment is based on the output for April, May and June.

### LANCASHIRE.

*(From our own Correspondents.)*

MANCHESTER.

**General Outlook.**

The market here for iron and metals is pondering over the fact that while non-ferrous metals have been improving and quite a large—or a comparatively large—business has been done by merchants, the state of the ferrous metals is worse than ever. All persons of experience in the metal trades realise that this is an unusual, if not an unnatural, state of things. When the industries using iron and metals begin to revive the first call, of course, is for iron and steel material; for iron and steel have to be used first, and then, after some months of work, comes the use of the non-ferrous metals. This, of course, applies to general engineering. Hence it is inferred that the demand for copper is more closely related to the low prices than to any great increase in the consumption. There is, of course, no doubt whatever about the adverse circumstances in the iron and steel trades. Reports of closing down works and blowing out of furnaces are too numerous to be ignored, and it is known that the trade, as a whole, is quite unprofitable.

**Metals.**

The position in copper looked very favourable up to the end of last week, but this week the buying is scarcely so active. Each time an upward movement in copper prices occurs there is a general expectation that the end of the low prices is at last in sight, and, of course, there is some buying in anticipation by consumers

and speculative merchants; but hitherto disappointment has always awaited the sanguine operator. If prices should again fall back after the little spurt the situation in the market will be worse than before. Part of the reason for the buying of copper has been the hope that, at long last, the German trouble is to be settled. America especially seems to be sanguine on this point; but it is by no means certain that the end of a long series of abortive or semi-abortive conferences is in sight. There has, however, been larger buying of copper by Germany recently, but apparently the prices obtained for this business have been lower than the ostensible American price. In other words, the American producers have been forcing sales by means of concessions not available in the open market. If this be so then these sales of copper cannot be considered as a "bull point" for the market. Makers of manufactured copper and brass have quickly responded to the better prices of raw copper by advancing sheets £2 per ton and copper and brass tubes by ½d. per pound. Dealers in old metal here have not advanced their buying prices for scrap, or if so only by a very trifling amount. They maintain that although there may be a better market for copper, tin and spelter, the demand for the old alloys is as poor as ever. The position in tin seems very uncertain. Undoubtedly the "bull" interests in the market are very strong; and if they are supported by any further large buying in America they may be able to quote prices above £260 per ton; but one is inclined to think that tin is now quite high enough. In this market, also, some of the expectations of higher prices and a larger demand are based upon the favourable outcome of the Conference dealing with German affairs. In the lead market there has been a sharp setback which may perhaps check the overweening confidence which was being expressed last week. Lead, of course, is unreasonably high; but spelter is at a fairly moderate price; and although the sharp fall in lead affected spelter sympathetically to the extent of about 5s. per ton, the prices seem fairly safe.

**Pig Iron.**

The market in Manchester for foundry iron is again very quiet and dull. This week less is being done than before, and last week the amount of business done seemed to have reached the minimum. There is some accumulation of foundry iron at the Midland furnaces, and this will perhaps account for the forced sales at low prices which have been reported lately. Some of the makers seem to be better off in this respect than others, but consumers seem convinced that the exceptional prices reported will soon be the regular prices; in fact, they are waiting for the time when No. 3 foundry iron will be sold again in Manchester at 90s. per ton. This does not appear to be so wild a hope as it was a month ago. Northamptonshire iron is now approaching 80s. at the furnaces, and Lincolnshire iron seems quite plentiful here at something under the price of Derbyshire. For the latter the stronger furnaces are now accepting orders at 95s. per ton delivered in Manchester. The state of the trade in castings does not improve, and it is clear now that the Lancashire founder is at a disadvantage compared with his competitors in Yorkshire, Northamptonshire and Staffordshire. Cleveland iron is now weak at 86s. on trucks, and is able again to compete with Derbyshire in almost all parts of Lancashire except Manchester. There is talk of reducing the number of Midland furnaces, but one fears that a big reduction will be needed if the supply is to be brought down to equality with the demand. Scotch iron is about as it was, but East Coast hematite is weaker again at about 106s. per ton for delivery in Manchester. The relationship between this and common foundry iron is, however, much as it was.

**Steel.**

The market for finished steel is weaker here and generally in the Midlands; and this is now recognised by a reduction of 2s. 6d. per ton in the ostensible prices for sections, making joists and angles in Manchester £9 12s. 6d. per ton. As a matter of fact, this price, and sometimes a little less, has been accepted in the Manchester district for quite a long time, and the reduction is only a belated recognition of what has been known for weeks. Common plates are quoted at £10 per ton and flat bars can be bought at the same price. The finished iron trade is very dull, and Lancashire works are short of orders; but this is not surprising while prices are kept so far above steel.

**Scrap.**

There is no very definite change in the scrap markets here. Ordinary steel melting scrap is in a doubtful condition; and as dealers do not know accurately what consumers are likely to give when they again begin to buy, they are offering only low prices for steel scrap in Lancashire. Probably 70s. per ton on trucks is now rather more than many dealers care to offer; but the scrap ought to be worth as much as that. Heavy wrought scrap is dull because of the lack of demand for bar iron. About 92s. 6d. per ton seems to be near the mark, for delivery at the ironworks. Foundry scrap is neglected, but nominally the price for broken machinery iron remains at 85s. per ton.

**James Sumner.**

One of the pioneers of the self-propelled vehicle movement in this country, James Sumner, died last week. Mr. Sumner was for many years very closely associated with the firm of Leyland Motors; in fact, the present firm may be said to be the outcome of a business of which he was the founder in the very early days of the motor vehicle. Two of Mr. Sumner's earliest productions were a steam tricycle and a steam-propelled lawn mower. Along with Mr. H. Spurrier, Mr. Sumner was largely responsible for the original works at Leyland for the construction of steam wagons, one of the earliest heavy vehicle factories, in this country. He retired from active participation in the management of the factory a few years ago owing to loss of his eyesight.

BARROW-IN-FURNESS.

**Hematite.**

There is no life in the hematite pig iron market, nor are there any signs of better trade at present The position seems to be that of marking time and waiting. It is true that if the steel trade could improve then a bigger output from the iron departments would be required, but what we want to see is improved demands for iron from all our old customers, who at present are either holding off or are waiting for cheaper iron. It will be a long wait before they get the latter, one is inclined to think. The trade done is for small parcels for quick delivery to meet the requirements of the customers in the immediate future. There is no placing of orders for forward delivery. The continental trade is as dull as can be, and trade across the Atlantic is small. A part cargo went to New York last week from Barrow, which is rather unusual, the ports generally being Baltimore or Philadelphia. The new regular service of the Johnstone line makes shipments of part cargoes more possible now.

**Iron Ore.**

The iron ore trade is as dull as the iron trade, and until there is a bigger demand for iron there will be quietness at the mines. There is not an appreciable amount going out of the district, and with the restricted number of furnaces in blast the ore trade is naturally only moderate. This condition of affairs will not improve until better conditions obtain in the iron trade. Foreign ore is arriving in restricted quantities.

**Steel.**

The steel trade is in a quiet way, and there are not many orders in the market, and for them there is much competition, which is not confined to this country. The Barrow rail mills are closed down this week, and may restart the following week, but it is not definitely known yet. Orders for rails held are not large. Workington rail mills start next week for a fortnight's run only. The hoop mills at Barrow are better situated, and their order sheet is pretty good. There have been shipments of these hoops to Wilmington and New Orleans. The section mills are also fairly well off for orders.

**Shipbuilding and Engineering.**

Shipbuilding and engineering departments are practically idle for the annual holidays this week, but there is plenty of work for the men to go back to. The Anglo-Newfoundland steamer, which is to be named the Geraldine Mary, is practically ready for launching. She is a big steamer, which will be used for the conveyance of newsprint from Newfoundland, and is part of the Northcliffe enterprise. The Donaldson liner is also due off the stocks soon. The keel of the new crusier Cumberland will be laid in one or other of the berths vacated. The Orient liner Orama is progressing rapidly, and will be delivered before the year is out, perhaps in November.

## SHEFFIELD.

*(From our own Correspondent.)*

**The Heavy Steel Trades.**

THERE is little that is now to report this week about the condition of the heavy steel trades of Sheffield and district. Owing to the Bank Holiday stoppage, the working week has been shorter than usual, and, for the same reason, there has been no change in the outlook. Very little business has been placed during the week with the firms making open-hearth steel, which are still in the position of finding new orders insufficient to replace old contracts as they are worked off. In the circumstances, the holidays were even more welcome than usual. The prospects of a turn for the better are not considered bright. The months of July and August are generally poor from a business point of view, and a revival of buying is not anticipated until the holiday season has run its course, although there are those who look forward to an improvement in September.

**A Labour Cloud.**

The situation in the open-hearth steel trade is darkened by a threat of labour trouble. For some time there has been difficulty with regard to the wages paid to semi-skilled men employed by the great firms of Steel, Peech and Tozer (Rotherham), Samuel Fox and Co. (Stocksbridge), and the Parkgate Iron and Steel Company. It is complained that the employers refuse to concede district rates to the semi-skilled men, and that in future they will not observe the district rates for the skilled men who are concerned in the dispute. A further effort is being made to obtain the restoration of district rates and conditions, and in the event of failure of the application, it is probable that seven days' notice to cease work will be tendered this week-end. The dispute affects about 6000 men.

**Other Steel Departments.**

Considerable tonnages of axles, tires, springs and other railway supplies are still being turned out, chiefly to the order of the British companies, but the departments could do with a good deal more work to keep them fully employed. The crucible steel trade continues to progress, and great activity is maintained in the manufacture of special steel for motor car purposes. This latter branch has, however, been detrimentally affected by the withdrawal of the McKenna duties. The actual lapsing of the duties last week made little difference to the position, the damage having been done when the Budget was introduced. It is generally agreed that a diminution of orders then set in, and one authority estimates that, if the duties had not been interfered with, the amount of business coming forward from the motor industry would have been from 30 to 35 per cent. more than it is at present. A good trade is being done in various steel tools, saws being one of the busiest lines, while the demand for files goes on improving.

**Sheffield Firm's Canadian Purchase.**

An interesting item of news this week is the fact that Spear and Jackson, Limited, of Ætna Works, Sheffield, has purchased the establishment of the Ætna Saw Company, of Vancouver. Messrs. Spear and Jackson are one of the oldest steel firms in Sheffield, and are very largely engaged in the manufacture of saws, and their intention is to extend the Vancouver works and operate them as a Canadian company, under the name of Spear and Jackson (B.C.), Limited. It is, of course, nothing new for a Sheffield firm to extend its operations to the Dominions, or even to foreign countries, with the object of getting inside a tariff wall, but Messrs. Spear and Jackson's reason is of a different character, and is full of interest, as illustrating the conditions of the times. In the words of Mr. A. K. Wilson, the governing director of the firm, they, like many others, are growing seriously alarmed at the trend of events in this country, and are seeking a footing in a British Overseas Dominion to which, in the event of manufacturing conditions here becoming impossible, they can transfer their energies.

**Menace of Present Conditions.**

"Taxation and rates," said Mr. Wilson in an interview, "are already so high that it is practically impossible in most lines of business to secure a return on capital invested which is worth the risk. But, in our opinion, a more deadly menace still is the spirit of trade union leadership in refusing to realise that you can push the doctrine of 'less work and more money' to a point where there will be no work and no money either, and in obstructing improved methods of production by refusing to adjust prices in a reasonable spirit. In our opinion, the industrial future lies with countries like Canada, where the working man realises that he can only get—and is getting—the improved standard of living he rightly desires, by giving a day's work for a day's pay, and by the increased use of machinery, which he welcomes and encourages." Mr. Wilson was, of course, speaking generally, and in his remark about men not giving a day's work for a day's pay, he was not referring to the Sheffield trades in particular.

**Munificent Gift to the University.**

The Applied Science Department of Sheffield University has long occupied a very leading position among the technical instruction centres of the world, and it is being assisted to maintain and improve that position by the gifts of generous friends. Only two or three years ago there were opened magnificent laboratories, equipped by two eminent steel manufacturers of the city, Mr. Edgar Allen and Mr. Joseph Jonas, while last year Alderman Robert Styring, a prominent Sheffield public man, gave the institution £20,000, a great part of which is devoted to the founding of post-graduate scholarships to enable graduates to pursue scientific research in ferrous or non-ferrous metals. Now the Department has received a gift of £10,000 from Lord Bearsted. The object of this donation is the encouragement of study and research in the Department of Metallurgy. Lord Bearsted has a long association with the University. In 1903, when, as Sir Marcus Samuel, he was Lord Mayor of London, he laid the foundation stone of the present University building. Last month he again visited the University to receive the honorary degree of Doctor of Laws. In his speech on that occasion, he expressed the opinion that in the future graduation from the Northern Universities would be regarded as essential in business. By his gift, he has supported his view in a practical manner, and has made graduation from Sheffield University a wider possibility.

**Rotherham Electricity Progress.**

The annual report of the Rotherham Corporation electricity department for the year ended March 31st last shows remarkable progress. The total number of units sold was 55,902,874, as against 39,613,426 in the previous year, an increase of 41 per cent. There were increases of 15,947,896 units for power and heat; 80,986 units for traction; and 260,556 units for light. The net profit was £41,224, as compared with £38,001. The average price received per unit was 1.024d., as against 1.276d., a reduction of a farthing; and the average net profit per unit was .177d.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

**The Trade Outlook.**

THE trade outlook in the North of England grows more and more serious, and unhappily there appears to be little prospect of an early improvement. Shipbuilding, engineering, and the iron and steel trades are all feeling the slump. The volume of new orders for iron and steel booked last month was the smallest that has been known in the trade for many years. In fact, had the iron and steel producers not started the month with fairly good order books, many must by now have been laid idle, through lack of markets. But many of these orders are nearing completion, and if they be not speedily replaced the ironmasters and steel makers may have reluctantly to contemplate the curtailment of output. Prices have been cut considerably, Cleveland pig iron now being 5s. per ton cheaper than it was at the beginning of July, but buyers are still holding off in the hope of further reductions. Not only has the home demand dwindled, but the export trade also, and this fact is reflected in the return of exports for the month of July, which are the lowest recorded since February of last year. The total reached only 73,686 tons, as compared with 85,777 tons in June, and 135,294 tons in May. The shipments of pig iron last month amounted to 32,524 tons, as against 37,795 tons in June. Scotland received 9061, and, strange though it may seem, Belgium, which is a keen competitor in the continental markets, was the largest foreign customer, 5705 tons of Cleveland pig iron being sent to that country; Italy took 3491 tons, France 2519 tons, and Germany 1975 tons. The exports of manufactured iron and steel fell in July to 41,162 tons, as against 47,982 tons in June, and 71,082 tons in May. The imposition of the tariff continues to have a very

adverse effect on the trade with India, and a total despatch last month of 9367 tons represented only about half of the quantity usually shipped.

**Cleveland Pig Iron Market.**

With the Cleveland pig iron market under holiday influences, there has been even less inclination than ever to do business this week. The general position cannot be described as otherwise than unsatisfactory and discouraging. Absence of transactions is more pronounced than is generally experienced at this quiet season of the year, and with a prevailing feeling of pessimism the outlook is gloomy. Lack of confidence in the future is holding up home business, and export sales are little heard of, continental firms underselling the products of this district in markets abroad. The few foreign customers disposed to place orders here have to face obstacles in the way of financing purchases of material. Consumers report that they can place orders below the market rates, but makers are disinclined to acknowledge any further cutting of prices. No. 1 is 90s. to 91s.; No. 3 G.M.B., 85s. to 86s.; No. 4 foundry, 84s.; and No. 4 forge, 83s.

**Hematite Pig Iron.**

In the East Coast hematite pig iron trade makers' stocks are stated to be heavy and steadily accumulating. Business continues on a very limited scale, and makers are faced with keen competition from French producers, who are selling at 10s. per ton below what the product of this district can be sold at abroad. Mixed numbers are quoted at 94s. per ton, and a further drop is expected.

**Ironmaking Materials.**

Business in the foreign ore trade is almost at a standstill, with best Rubio nominal at 23s. per ton c.i.f. Tees. Good medium furnace coke is about 26s. 6d. per ton delivered at the works.

**Manufactured Iron and Steel.**

Conditions in the manufactured iron and steel trade vary considerably. Sheet makers are running at full capacity, and some firms are fairly well occupied on shipyard specifications, whilst a few orders for rails have been secured. In most other branches, however, manufacturers are getting through work on hand, and they find much difficulty in securing orders to follow on those expiring contracts. At the same time, a growing feeling that the worst of the depression has been experienced inspires hope that a step in the direction of improvement in demand may be looked for in the near future. Prices are unchanged.

**The Coal Trade.**

The Northern coal trade shows little movement. The position for prompt supplies is rather better in all descriptions, but there is very little business on offer beyond August shipment, both contractors and overseas buyers being apparently inclined to hold off. For early loading many grades are steadier, but prices of any class depend almost entirely on individual circumstances. Competition from Germany is very severe at all continental centres, and good class German manufacturing fuels, with guaranteed analysis, are on offer at Ghent and similar ports at 80f., or less than £1 per ton, with screened steams, gas, and other grades at relative figures. Other advices state that Ruhr producers have fully 1,000,000 tons of coal stacked at the pitheads. With these factors to contend against, Northern coal fitters take a gloomy view of the forward prospects. There are a few inquiries for best Northumberland steams, but business comes forward very slowly, prices offered being much below producers' ideas. There is no new feature in the Durham gas coal section. The coke trade is steady, and while makers are now well supplied with orders for August, there is still a surplus for disposal, and sellers continue to quote recent values.

## SCOTLAND.

*(From our own Correspondent.)*

**Clyde Shipbuilding.**

THE intervention of the annual fair holidays was partly responsible for the comparatively small output from Clyde shipyards during the month of July. At the same time there may be an indication of a slowing down of production as in former years a holiday month often preserved a good average output. The output for July is the second lowest for this year to date, having only been eclipsed in this respect by the returns for February. The output for last month amounted to fifteen vessels of 27,835 tons aggregate, while the figures for the seven months reached a total of 133 vessels of 282,202 tons aggregate, compared with 63 vessels of 146,411 tons during the same period last year. Launches during last month included only three vessels over four thousand tons each:—Asuka Maru, twin-screw cargo motor ship, 7500 tons, built for the Nippon Yusen Kaisha, Tokio; Cedarbank, twin-screw motor ship, 5200 tons, for the Bank Line, A. Weir and Co., Glasgow and London; and the Farnworth, cargo steamer, 4780 tons, for R. S. Dalgliesh (Limited), Newcastle-on-Tyne. New contracts placed during July were extremely few in number, amounting to four in all, and of small tonnages. A somewhat disturbing feature is revealed in the announcements made from time to time of boats being sent abroad for completion or repairs. A considerable amount of work is thus being lost to the shipyards, and probably also to the local steel and ironworks. Labour troubles have been threatening, but it is not anticipated that anything of a serious nature will occur in the near future, at any rate. If the general depression in the shipping trade were to ease, the shipbuilding trade would probably receive some benefit. The number of men presenting themselves at the yards immediately after the holidays has been much larger than usual in fact, quite a contrast to pre-war experiences.

**Weaker Pig Iron.**

The dulness in the pig iron market becomes more apparent. The demand for foundry qualities is especially poor, and there is a probability that some furnaces will be closed down unless an early improvement takes place. Prices have receded further, foundry No. 1 having been quoted round about £4 18s., and foundry No. 3 £4 13s. per ton delivered Glasgow. Hematite is in not much if any better demand than foundry, and the price has fallen to about £4 15s. per ton delivered Glasgow.

**Finished Steel and Iron.**

Generally speaking, few steel makers are well placed for orders at present. Business did not accumulate to any extent over the holidays, and plants are more or less poorly employed. Specifications for steel plates and sections are far below expectations, and orders from structural engineers are also disappointing. The export demand for thin steel sheets continues to provide the bright spot. Both black and galvanised varieties are busy and makers are not in a position to accept orders for early delivery. Bar iron shares in the general depression, and re-rolled steel is in the same category. The outlook, on the whole, is somewhat depressing, and increased offerings of foreign material cause increased anxiety.

**Coal Exports Increasing.**

A better feeling has been apparent in the coal market during the past few days. Foreign buyers are showing more real interest, and some descriptions of round fuel are tending to harden in price, while treble nuts from Fifeshire and the Lothians have already appreciated about 2s. per ton. Lanarkshire collieries are not feeling much benefit so far, but in Ayrshire a ready outlet is experienced. Fifeshire navigations are sixpence to a shilling firmer, and Fifeshire steams are about 1s. firmer. In Fifeshire and the Lothians treble nuts are sold a few weeks ahead. The difficulties in the way of extensive forward negotiations still exist, but it is hoped that buyers are becoming more convinced that prices for this class of business are not likely to alter in a downward direction for some time at least. The home market remains comparatively idle.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

**Coal Trade Position.**

THE steam coal trade is quiet, and for the time being is unsettled by holiday influences. There was no work in the coalfield this week until Thursday, and shipment operations at the docks were not resumed until Wednesday morning, so that in the circumstances it will be fully next week before the position can be properly gauged. The loss of output this week should enable most of the colliery owners who have had fairly heavy stocks to reduce them to some extent, and, in fact, the probability that production throughout this month will be small should have a steadying influence upon the market. Meanwhile, it is true that the general inquiry from the Continent is meagre, and it is for that reason that some exporting firms, which hold moderately large supplies of coal on contract are experiencing some difficulty in finding an outlet for the coals, and are therefore disposed to take rather low prices, provided they can effect sales. The view, however, is that, in spite of these sales, the conditions should improve during the next few weeks, more especially as during the past month exports have been falling away. It is interesting to note that whereas during the first week of July exports from this district totalled over 600,000 tons, the figure for the week ending August 1st was under 470,000 tons.

**Coalfield Items.**

At the end of last week the Dufiryn Rhondda Collieries in the Avon Valley closed down for an indefinite period, the stoppage being due to the fact that the collieries are unremunerative under present conditions. About 1200 men are affected. Last week about 3000 miners engaged at the Cambrian Collieries, Clydach Vale, came out on strike, their reason being that the management had refused to continue long-standing custom in respect of the payment of hauliers. However, before the end of the week the strike terminated, and the men returned to work. In the case of the International Colliery, Blaengarw, where the men received notices, it being the intention of the owners to close down the colliery, it is now arranged that the men shall work on day-to-day contracts. Had this stoppage taken place, about 1000 men would have been thrown out of employment.

**Coalfield Agreement.**

There is now every reason to believe that the area agreement for the South Wales coalfield will be shortly arrived at and signed. Delay has been caused by differences arising regarding the exact terms, but when the Joint Committee which has been dealing with the matter meets on the 26th inst., it is fully expected that the agreement will be signed. Considerable progress was made at a meeting held last week, when the subject of anomalies which the representatives of the workmen contend have cropped up as a result of the new wages agreement, was discussed.

**Tin-plate Trade.**

The annual holidays in the tin-plate trade commenced on Thursday in last week, when the works ceased operations for a week. Altogether, about 10,000 men are affected. Many of the men are not, however, feeling very satisfied with the result of the proceedings of the annual meeting of the Industrial Council held last week at Swansea. It is understood that several of the men's union branches have had meetings, when dissatisfaction was expressed with the lack of concessions which the employers made to the demands of the workmen. In some instances resolutions were passed demanding immediate action.

**Anthracite Colliery Deal.**

It is authoritatively stated that negotiations are practically concluded whereby the United Anthracite Collieries, Limited, acquire the Rhos, Carway, Gwaun-dreath and Caebryn collieries in the Amman and Gwaun-dreath Valleys, now belonging to Messrs. Napier and Co., of Swansea. These properties produce anthracite coals of a high grade, and are well known in this district and abroad. It is fully expected that before very long an official statement will be issued confirming the deal.

**Current Business.**

Business has practically been at a standstill since I wrote a week ago. During the last few days of last week operations came to a end, owing to the holidays, and so far as this week is concerned, the Coal Exchange was not opened until Wednesday morning, and very little could then be done, owing to the fact that colliery salesmen could not very well tell what their position would be for supplies of coal, as there was no work in the coalfield during the first three days of this week. Most exporters, however, had, earlier, made their arrangements for the loading of steamers, which were to have arrived during the vacation, so that there was no pressing demand for coals for quick delivery. Values of most grades are, for the time being, nominal, but an improvement in small coals particularly is looked for in view of the limited production generally.

## Catalogues.

WILLIAMS AND WOMERSLEY, Wakefield.—Copy of price list of "Apex" universal four-way adjustable fixings.

PETER BROTHERHOOD, Limited, Peterborough.—Catalogue on the Brotherhood ammonia refrigerating machinery.

BURROUGHS, WELLCOME AND CO., Snow Hill Buildings, E.C. 1.—Photographic booklet entitled "Foresight in Photography."

NOTTINGHAM COLWICK ESTATES, Limited, Colwick, near Nottingham.—Brochure entitled "Britain's best industrial sites."

LE CARBONE, Coventry House, South-place, E.C. 2.—Catalogue of "A D" cells (air depolariser) primary cells in dry and wet form.

HYATT, Limited, 56, Victoria-street, S.W. 1.—Leaflets I.N. 40 and I.N. 42 on self-aligning axle boxes (heavy and light types respectively).

GWYNNES ENGINEERING COMPANY, Limited, Hammersmith Iron Works, London, W. 6.—Booklet on the centrifugal pump and its application to industry.

CAMBRIAN WAGON COMPANY, Limited.—Catalogue of railway wagons which the firm manufactures. Also a list of depôts where railway wagons may be repaired.

HENRY J. COLES, Limited.—London Crane Works, Slack-lane, Derby.—Illustrated booklet on steam and electric cranes, steam crane navvys and single and double-chain grabs.

CROMPTON AND CO., Limited, Chelmsford.—Booklet issued to commemorate the British Empire Exhibition exhibits of the electrical machinery which this firm manufactures.

BRUCE, PEEBLES AND CO., Limited, Edinburgh.—Booklet No. 706 C. describing the firm's works and manufactures. A section on the industrial application of electricity is included.

FLUXITE, Limited, Simplex Works, Bevington-street, Bermondsey, S.E. 16.—Leaflet on the use of Fluxite, soldering paste for case-hardening and hardening and tempering tools.

SIEMENS BROTHERS AND CO., Limited, Woolwich, S.E. 18.—Catalogue 805 on Siemens water pyrometer. A cut-out folder in the form and size of the Siemens automatic telephone dial.

WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Limited. 82, York-road, King's Cross, N. 1.—Copy of catalogue section S. 9, entitled "Double wire signalling for British and Colonial Railways."

THE HOFFMANN MANUFACTURING COMPANY, Limited, Chelmsford.—Catalogue of line shaft bearings. Particulars of a lighter type of bearing suitable for light duty are embodied in this new catalogue.

GOODBRAND AND CO., Limited, Britannia Foundry, Stalybridge.—Desk paper weight in glass. A view of one of the fuel economisers manufactured by the company is reproduced and shows through the glass.

HATTERSLEY (ORMSKIRK), Limited, Ormskirk, Lancs.—Illustrated catalogue of gun-metal and cast iron valves and cocks, steam, heating, fire and water fittings, also extruded metals and metal alloys.

WALSALL HARDWARE MANUFACTURING COMPANY, Limited, Hatherton Works, Albewell-street, Walsall.—Illustrated catalogue of "Walsall" steel conduits, fittings and accessories for electric light and power wiring.

IMPAG, Limited, 88, Fenchurch-street, E.C. 3.—Catalogue describing the insulating materials manufactured by Micafil, Limited, of Zurich-Altstetten, Switzerland, for which Messrs. Impag are the sole agents for Great Britain.

ASHMORE, BENSON, PEASE AND CO., Limited, Stockton-on-Tees.—Gas plant catalogue containing particulars of gas-holders, purifying plants, condensers, scrubbers, benzol refining plants, and a few illustrations of water gas plants.

SWISS LOCOMOTIVE AND MACHINE WORKS, Winterthur.—We have received from the British representatives, Bernard Holland and Co., of 17, Victoria-street, S.W. 1, a copy of a pamphlet on rack railways, both steam and electric.

THE VICTAULIC COMPANY, Limited, King's Building, Dean Stanley-street, S.W. 1.—Copy of the Victaulic price list of welded or weldless tubes with Victaulic flexible leak-tight joints; tubes and joints complete; fittings, blank ends, valves, &c.

SULLIVAN MACHINERY COMPANY, Salisbury House, E.C. 2.—Bulletin 70 X on the Sullivan spader, Class D.E. 361. Bulletin No. 77 H on Sullivan angle-compound power-driven air compressors, both belted and direct connected. Bulletin No. 77 K, Sullivan belt-driven air compressors, single-stage types, also two-stage types. Bulletin No. 78 B on Sullivan dry vacuum pumps, single cylinder, steam and belt driven.

THE MIRRLEES WATSON COMPANY, Limited, Scotland-street, Glasgow.—The following pamphlets have been received: Pu. 2, Mirrlees surface condensers; Pu. 3, Dalmarnock surface condensing plant; Pu. 50, Mirrlees de-aeration systems; Pu. 100, Mirrlees jet condensers; Pu. 360, ejector air pump with intermediate surface condenser. Publication No. 601 describing the Mirrlees Watson patented condensate extraction pump.

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| N.W. COAST— | |
| Native | 17/6 to 24/- |
| (1) Spanish | 23/- |
| (1) N. African | 23/- |
| N.E. COAST— | |
| Native | — |
| Foreign (c.i.f.) | 22/6 |

## PIG IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| (2) SCOTLAND— | | |
| Hematite | 4 16 3 | — |
| No. 1 Foundry | 4 18 9 | — |
| No. 3 Foundry | 4 13 9 | — |
| N.E. COAST— | | |
| Hematite Mixed Nos. | 4 14 0 | 4 14 0 |
| No. 1 | 4 15 0 | 4 15 0 |
| Cleveland— | | |
| No. 1 | 4 10 0 | 4 10 0 |
| Silicious Iron | 4 10 0 | 4 10 0 |
| No. 3 G.M.B. | 4 5 0 | 4 5 0 |
| No. 4 Foundry | 4 4 0 | 4 4 0 |
| No. 4 Forge | 4 3 0 | 4 3 0 |
| Mottled | — | — |
| White | — | — |
| MIDLANDS— | | |
| (3) Staffs.— | | |
| All-mine (Cold Blast) | 9 2 6 | — |
| North Staffs. Forge | 4 5 0 | — |
| „ „ Foundry | 4 10 0 | — |
| (3) Northampton— | | |
| Foundry No. 3 | 4 2 6 | |
| „ Forge | 4 0 0 | — |
| (3) Derbyshire— | | |
| No. 3 Foundry | 4 7 6 | |
| Forge | 4 4 0 to 4 5 0 | |
| (3) Lincolnshire— | | |
| No. 3 Foundry | 4 10 0 to 4 12 6 | — |
| No. 4 Forge | 4 12 6 to 4 15 0 | — |
| Basic | 4 5 0 to 4 10 0 | |
| (4) N.W. COAST— | | |
| N. Lancs. and Cum.— | | |
| Hematite Mixed Nos. | {5 10 0 (a) / 5 15 0 (b) | — |

## MANUFACTURED IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| SCOTLAND— | | |
| Crown Bars | 12 10 0 | — |
| Best „ | — | — |
| N.E COAST— | | |
| Common Bars | 12 10 0 | — |
| LANCS — | | |
| Crown Bars | 13 0 0 | — |
| Second Quality Bars | 12 0 0 | — |
| Hoops | 15 0 0 | 14 15 0 |
| S. YORKS.— | | |
| Crown Bars | 13 10 0 | — |
| Best „ | 14 0 0 | — |
| Hoops | 15 0 0 | — |
| MIDLANDS— | | |
| Crown Bars | 13 0 0 | — |
| Marked Bars (Staffs.) | 15 0 0 | — |
| Nut and Bolt Bars | 12 0 0 | — |
| Gas Tube Strip | 13 5 0 to 13 7 6 | — |

## STEEL.

| | (6) Home. £ s. d. | (7) Export. £ s. d. |
|---|---|---|
| (5) SCOTLAND— | | |
| Boiler Plates | 13 10 0 | — |
| Ship Plates, ¼in. and up | 10 5 0 | — |
| Sections | 10 0 0 | — |
| Steel Sheets, 3/16in. to ¼in. | 12 10 0 | — |
| Sheets (Gal. Cor. 24 B.G.) | — | 18 10 0 |

## STEEL (*continued*).

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| N.E. COAST— | | |
| Ship Plates | 10 5 0 | — |
| Angles | 10 0 0 | — |
| Boiler Plates | 13 10 0 | — |
| Joists | 10 0 0 | — |
| Heavy Rails | 9 0 0 | — |
| Fish-plates | 13 0 0 | — |
| Channels | 10 5 0 | £9 to £9 5 |
| Hard Billets | 9 10 0 | — |
| Soft Billets | 8 10 0 | — |
| N.W. COAST— | | |
| BARROW— | | |
| Heavy Rails | 9 5 0† | — |
| Light „ | 9 10 0 to 10 0 0† | |
| Billets | 8 10 0 to 12 0 0† | |
| MANCHESTER— | | |
| Bars (Round) | 10 5 0 to 10 15 0 | |
| „ (others) | 10 0 0 to 10 2 6 | |
| Hoops (Best) | 15 5 0 | 15 0 0 |
| „ (Soft Steel) | 13 15 0 | 13 10 0 |
| Plates | 10 0 0 to 10 5 0 | — |
| „ (Lancs. Boiler) | 13 10 0 | — |
| SHEFFIELD— | | |
| Siemens Acid Billets | 12 10 0 | — |
| Bessemer Billets | 13 0 0 | — |
| Hard Basic | 9 10 0 | |
| Intermediate Basic | 9 0 0 | |
| Soft Basic | 8 5 0 to 8 10 0 | |
| Hoops | 12 10 0 to 13 0 0 | |
| Soft Wire Rods | 11 0 0 to 11 10 0 | |
| MIDLANDS— | | |
| Sma'l Rolled Bars | 9 15 0 to 10 10 0 | |
| Billets and Sheet-bars | 7 12 6 to 7 15 0 | |
| Sheets (20 W.G.) | 11 10 0 to 12 0 0 | |
| Galv. Sheets, f.o.b. L'pool | 18 5 0 | — |
| Angles | 9 15 0 to 10 0 0 | |
| Joists | 9 15 0 to 10 0 0 | |
| Tees | 10 15 0 to 11 0 0 | |
| Bridge and Tank Plates | 10 10 0 | — |
| Boiler Plates | 14 0 0 | — |

## NON-FERROUS METALS.

| | |
|---|---|
| SWANSEA— | |
| Tin-plates, I.C., 20 by 14 | 22/7½ to 23/- |
| Block Tin (cash) | 242 5 0 |
| „ (three months) | 242 10 0 |
| Copper (cash) | 63 5 0 |
| „ (three months) | 64 5 0 |
| Spanish Lead (cash) | 33 15 0 |
| „ (three months) | 32 0 0 |
| Spelter (cash) | 32 13 9 |
| „ (three months) | 32 10 0 |
| MANCHESTER— | |
| Copper, Best Selected Ingots | 70 0 0 |
| „ Electrolytic | 71 0 0 |
| „ Strong Sheets | 91 0 0 |
| „ Tubes (Basis price) | 0 1 1¼ |
| Brass Tubes (Basis price) | 0 1 0 |
| „ Condenser | 0 1 2¼ |
| Lead, English | 35 0 0 |
| „ Foreign | 33 15 0 |

## FERRO ALLOYS.

*(All prices now nominal.)*

| | Per Ton. | Per Unit. |
|---|---|---|
| Tungsten Metal Powder | 1/8½ per lb. | |
| Ferro Tungsten | 1/4½d. per lb. | |
| Ferro Chrome, 4 p.c. to 6 p.c. carbon | £24 0 0 | 10/6 |
| „ 6 p.c. to 8 p.c. „ | £23 10 0 | 8/- |
| „ 8 p.c. to 10 p.c. „ | £23 0 0 | 8/- |
| „ Specially Refined | | |
| „ Max. 2 p.c. carbon | £42 10 0 | 16/- |
| „ „ 1 p.c. „ | £51 0 0 | 17/6 |
| „ „ 0.75 p.c. carbon | £68 0 0 | 20/- |
| „ „ carbon free | 1/5 per lb. | |
| Metallic Chromium | 4/2 per lb. | |
| Ferro Manganese (per ton) | £15 for home, £15 for export | |
| „ Silicon, 45 p.c. to 50 p.c. | £12 0 0 | scale 5/- per unit |
| „ „ 75 p.c. | £18 10 0 | scale 6/- per unit |
| „ Vanadium | 19/3 per lb. | |
| „ Molybdenum | 8/3 per lb. | |
| „ Titanium (carbon free) | 1/3 per lb. | |
| Nickel (per ton) | £135 | |
| Cobalt | 10/6 per lb. | |
| Aluminium (per ton) | £120 to £130 | |

## FUELS.

### SCOTLAND.

| | Export. |
|---|---|
| LANARKSHIRE— | |
| (f.o.b. Glasgow)—Steam | 17/3 |
| „ „ Ell | 19/6 |
| „ „ Splint | 20/6 to 23/6 |
| „ „ Trebles | 21/6 |
| „ „ Doubles | 18/- |
| „ „ Singles | 17/- |
| AYRSHIRE— | |
| (f.o.b. Ports)—Steam | 17/6 |
| „ „ Splint | 20/6 |
| „ „ Trebles | 21/6 |
| FIFESHIRE— | |
| (f.o.b. Methil or Burntisland)—Steam | 15/6 to 20/- |
| Screened Navigation | 26/- |
| Trebles | 23/- to 25/- |
| Doubles | 18/6 |
| Singles | 17/6 |
| LOTHIANS— | |
| (f.o.b. Leith)—Best Steam | 18/6 |
| Secondary Steam | 17/6 |
| Trebles | 23/6 |
| Doubles | 19/- |
| Singles | 17/- |

### ENGLAND.

| | Inland. |
|---|---|
| (8) N.W. COAST— | |
| Steams | 20/- |
| Household | 45/- to 58/4 |
| Coke | 31/6 |
| NORTHUMBERLAND— | |
| Best Steams | 20/3 to 20/6 |
| Second Steams | 18/6 to 19/- |
| Steam Smalls | 10/6 |
| Unscreened | 16/- to 17/- |
| Household | 27/6 |
| DURHAM— | |
| Best Gas | 22/3 to 22/6 |
| Second | 19/- to 19/6 |
| Household | 27/6 |
| Foundry Coke | 25/- to 26/- |
| SHEFFIELD— | |
| Best Hand-picked Branch | 32/- to 33/- — |
| Barnsley Best Silkstone | 26/- to 28/- — |
| Derbyshire Best Brights | 25/- to 27/- — |
| „ „ House | 23/- to 25/- — |
| „ „ Large Nuts | 21/- to 25/- — |
| „ „ Small „ | 15/- to 17/6 — |
| Yorkshire Hards | 21/6 to 22/6 — |
| Derbyshire „ | 21/- to 23/- — |
| Rough Slacks | 12/6 to 15/6 — |
| Nutty „ | 12/- to 14/- — |
| Smalls | 8/- to 10/- — |
| Blast-furnace Coke (Inland)* | — — |
| „ „ (Export) | f.o.b. 25/ to 26/- |

### (9) SOUTH WALES.

| | |
|---|---|
| CARDIFF— | |
| Steam Coals: | |
| Best Smokeless Large | 28/- to 28/6 |
| Second „ „ | 27/- to 28/- |
| Best Dry Large | 26/6 to 27/- |
| Ordinary Dry Large | 25/- to 26/- |
| Best Black Vein Large | 26/6 to 27/- |
| Western Valley „ | 26/- to 26/6 |
| Best Eastern Valley Large | 25/- to 26/- |
| Ordinary „ „ | 24/- to 25/- |
| Best Steam Smalls | 16/6 to 17/- |
| Ordinary „ | 15/ to 16/- |
| Washed Nuts | 25/- to 27/- |
| No. 3 Rhondda Large | 27/- to 28/- |
| „ „ Smalls | 22/6 to 23/- |
| No. 2 „ Large | 24/- to 25/- |
| „ „ Through | 20/- to 22/6 |
| „ „ Smalls | 15/- to 16/- |
| Foundry Coke (export) | 47/6 to 55/- |
| Furnace Coke (export) | 30/ to 35/- |
| Patent Fuel | 27/- to 29/- |
| Pitwood (ex ship) | 28/- to 29/- |
| SWANSEA— | |
| Anthracite Coals: | |
| Best Big Vein Large | 50/- to 52/6 |
| Seconds | 42/6 to 45/- |
| Red Vein | 27/6 to 30/- |
| Machine-made Cobbles | 57/6 to 60/- |
| Nuts | 52/6 to 60/- |
| Beans | 39/- to 41/- |
| Peas | 23/- to 25/- |
| Breaker Duff | 9/9 to 10/3 |
| Rubbly Culm | 14/6 to 15/- |
| Steam Coals: | |
| Large | 24/- to 25/- |
| Seconds | 22/- to 23/- |
| Smalls | 15/- to 19/- |
| Cargo Through | 18/- to 20/- |

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o b. for export. (9) Per ton f.o.b.

* For blast furnaces only, 21/- to 25/-; open market, 27/6 to 28/6. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

# French Engineering Notes.

(*From our Correspondent in Paris.*)

### Trade Organisation.

So long as trade remains in its present chaotic state, the future will necessarily cause a good deal of uneasiness amongst manufacturers, and the outlook can only be assured by a suitable organisation which will take into account all the developments that may possibly arise. This was the reason for the creation of the Superior Consulting Council of Commerce and Industry, the inaugural meeting of which was held last week, when the Minister of Commerce delivered an exhaustive address upon the general lines that should be followed in order to allow the French iron, steel and engineering trades to profit from the exceptional position in which it has been placed by the economic readjustment resulting from the war. France is now the largest producer of iron and steel in Europe, and her manufacturing resources have been enormously increased during the past decade. The production is so far in excess of home requirements that manufacturers must look to foreign markets, and, for that reason, France must modify her policy of commercial arrangements, such as have already been made with a number of small States. Nothing, however, has been done with the big producing markets, and one of the objects of the Superior Consulting Council is to establish a basis for such commercial arrangements, the most important of which is necessarily that with Germany. While possessing considerable resources, France cannot utilise them without foreign coal and coke, and so far as concerns Alsace and Lorraine especially, there seems to be little hope for the future, except by a close collaboration with Germany. It has even been suggested that some of the Ruhr collieries should be ceded to France in payment for reparations, so that the restored provinces would be assured of sufficient supplies of fuel. It is clear, however, that Germany would never consent to any such bargain, and as that country will recover its economic liberty in January next, some commercial arrangement must be entered into with Germany if the restored provinces are not to be deprived even of their means of existence. The French have endeavoured so far to preserve an absolute independence by dealing separately with different countries, but it appears likely that a commercial reorganisation can only be effected by a more general arrangement, resembling the old treaties of commerce which the French professed they had relinquished definitely. A treaty of commerce with Germany would imply similar treaties with Britain and other countries, and it is only when some stable basis of commercial transactions has been established that there can be any hope of a continuous trade recovery. The deadlock which has taken place in the commercial negotiations between France and Belgium shows how difficult it is to carry out partial treaties under present conditions. Another matter to be dealt with by the Superior Consulting Council will be the provision of means of fixing prime costs. With the present fluctuations it is quite impossible to know exactly the actual cost of production, and if French producers are to carry on a successful competition in foreign markets they must be able to fix the lowest prices compatible with reasonable profits. The Council therefore proposes to collect all data relating to costs.

### Public Works.

The policy of severe retrenchment in all departments of public expenditure adopted by the previous Government is now being modified in the sense that larger sums are being voted wherever such a course is considered necessary. An additional amount of 12 million francs, for example, has been set aside for public works. This step would appear to be justified by the fact that since the retrenchment scheme was put into operation there has been a complete lull in the engineering trades. Some departments, such as locomotive building, have been hit severely. Leading firms have been obliged to extend the scope of their manufactures so as to provide employment in the works. The dissolution of one of the oldest boiler-making firms has resulted in the business being transferred to a locomotive building shop in the Department of the Rhone. An additional expenditure on public works cannot, of course, revive confidence so long as the exchange rate fluctuates as it has been doing during the past week. In view of the uncertain situation produced by the fluctuations, business is at a standstill, and the only hopeful feature at the moment is that the depreciation of the franc may result in a renewed demand on foreign account.

### A Novel Bridge.

At Rabastens-sur-Tarn there has just been completed a bridge with each arch built up of two stone ribs, with a space between, upon which is laid the roadway. There are two arches, each of 55 m., and the height above the river is 29 m. The two stone ribs of each arch each have a width of 1.80 m., and they are separated by a space of 2.40 m. It is stated that of the twelve bridges of this type existing in Europe and America, the one built at Rabastens is the highest.

### Iron and Steel Production.

In the report just issued by the Comité des Forges, the number of furnaces in blast on July 1st is stated to have been 135, which is the same number as in the previous month. There was, however, a diminution of 19,524 tons in the production of pig iron, the total being 638,873 tons. The total output of raw steel was 534,921 tons, a decrease of 43,506 tons. This implies a slowing down of production, which is due to a smaller demand and not to any falling off in the supplies of fuel, for the deliveries of coke are quite sufficient to meet the needs of the blast-furnaces. Nevertheless, there is some uneasiness as to what will happen to the stocks of coal and coke if the French should evacuate the Ruhr.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

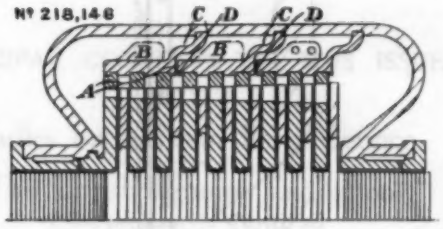
*Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

### TURBINE MACHINERY.

218,146. August 20th, 1923.—Steam Turbines, K. Baumann, Northwood House, Barnfield, Urmston, Lancashire, and the Metropolitan-Vickers Electrical Company, Limited, 4, Central Buildings, Westminster.

The stationary blades A A of this turbine are fixed in stators

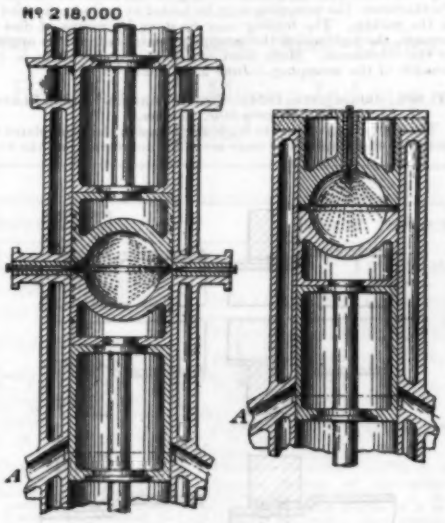



B B, which are secured in the main casing by means of flexible diaphragms C C. Gaps D D are provided between the several stators, so that they may be subject to the steam pressure on both sides.—*July 3rd, 1924.*

### INTERNAL COMBUSTION ENGINES.

218,000. March 28th, 1923.—Combustion Chambers, R. P. Doxford and K. O. Keller, Pallion Yard, Sunderland.

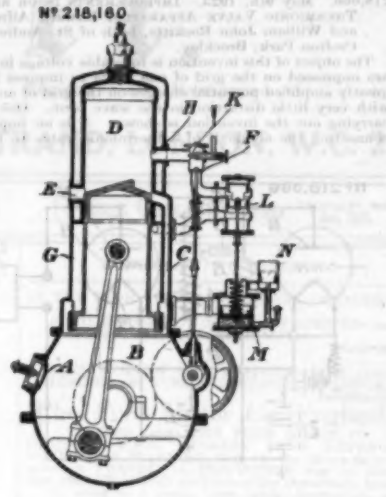
This invention aims at the reduction of damage to the cylinder walls, and the loss of heat to the water jacket consequent on the adoption of a whirling action for the incoming air in conjunction with a "curtain," or flat fan-shaped jet of fuel. The piston head is consequently devised with a hemispherical




concavity, while the cylinder head or opposed piston has a corresponding cavity. The scavenging air inlet ports A A are arranged tangentially to produce the whirling motion, while the jet producing the curtain of fuel is so arranged that it delivers when the two hemispheres come together at the end of the stroke, and practically cut off contact between the cylinder walls and the burning gases.—*June 30th, 1924.*

218,160. September 18th, 1923.—Two-stroke Engines, F. Gruebler, P.O. Box, Seidengasse, Zurich, Switzerland.

This invention relates to a two-stroke engine which, it is claimed, will operate efficiently at varying attitudes. A stepped piston is used to force air from an annular pump chamber above the piston into the working cylinder. The amount of air so delivered is controlled by a sliding valve L operated by a piston M which is open to atmospheric pressure on one side, while on the other side it is subjected to fluid pressure which is unaffected to any appreciable degree by the variations in atmospheric pressure at varying altitudes. On the upstroke of the piston air is drawn through the non-return valve A into the crank case B. It is compressed on the downstroke and passes up through the channel C into the cylinder space D, where the usual scavenging operation takes place and the exhaust gases are expelled through the port E. The rising piston now covers the scavenge air and exhaust ports, and the cam-operated valve F opens, allowing compressed air to pass from the pump chamber G through the inlet H into the cylinder. Fuel is introduced into the air current by a carburetter or fuel valve shown at K. After the fuel charge is completed the opening H is covered by the piston, and when the piston reaches the top dead centre the mixture is ignited by the spark plug and combustion takes place. On the working stroke the air contained in the annular pump chamber G and the pipe communicating to the slide valve L is expanded until the ports at the bottom of the cylinder are uncovered by the stepped piston, and part of the air compressed in the crank chamber is forced into the pump chamber, where it is again compressed on the upstroke of the piston. The air passing from the pump chamber G to the cylinder D is throttled by the slide valve L, the position of which valve varies automatically with the altitude. Considerable throttling takes place at low altitudes, but when higher altitudes are reached the controlling piston M lifts the valve L and the throttling is reduced so that the compression pressure in the working cylinder is retained uniform at varying altitudes. The desired result is obtained by a control piston M, the upper face of which is subjected to atmospheric pressure and the lower face to oil pressure

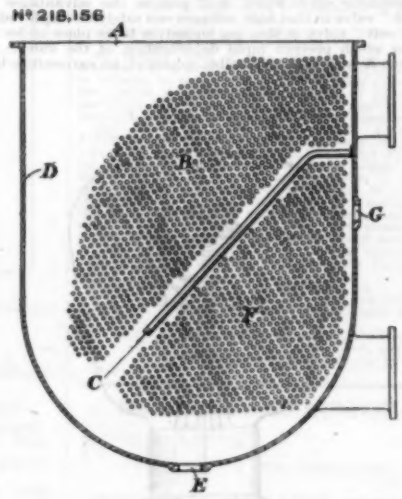



maintained by a weighted plunger N. A modified form of engine with a top inlet valve is also described and illustrated.—*July 3rd, 1924.*

### CONDENSERS AND FEED-WATER HEATERS.

218,156. September 10th, 1923.—Steam Condensers, G. and J. Weir, Limited, Cathcart, Glasgow, and J. G. Weir.

This condenser is so arranged that the condensate is delivered to the extraction pumps at the highest possible temperature, while the temperature of the uncondensable vapours is reduced as far as possible. The steam, entering the condenser at A, is condensed by the second-pass cooling tubes B, and the condensate

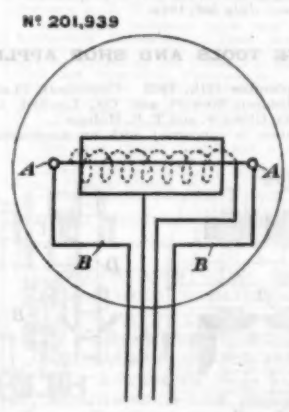



flows down the baffle C. Part of the steam, however, goes straight through the untubed space D and encounters the falling condensate, which is consequently warmed, and is drawn off at E. The remaining steam and uncondensable vapour flows upward through the cold, first-pass, cooling tubes F to the air extraction branch G.—*July 3rd, 1924.*

### TELEGRAPHS AND TELEPHONES.

201,939. August 3rd, 1923.—Improvements in or relating to Electrionic Discharge Tubes, *Compagnie pour la Fabrication des Compteurs et Matériel D'Usines a Gaz, 12, Place des Etats-Unis, Montrouge (Seine), France.*

According to this invention, the objectionable humming noise

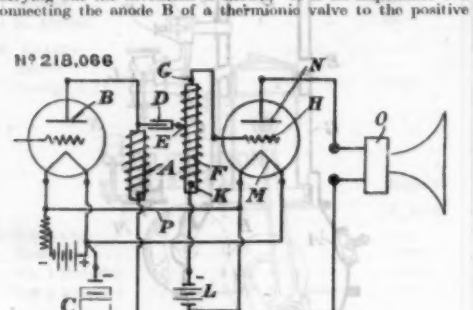



resulting from the use of alternating current for heating the filaments of thermionic valves is overcome. It has been found that the trouble is largely due to the variations in temperature of the filament. In ordinary valves the heat stored is too small to maintain the temperature of the filament sufficiently con-

stant. The filament used by the inventors absorbs 2 ampères at a pressure of 2 volts, and at the ends of the filament there are two polished metal knobs A for the storage of heat. The supports B are made as fine as possible in order to avoid conduction losses.—*July 3rd*, 1924.

218,066. May 9th, 1923.—Improvements in or relating to Thermionic Valve Apparatus, Edward Alfred Graham and William John Reckitts, both of St. Andrew's Works, Crofton Park, Brockley.

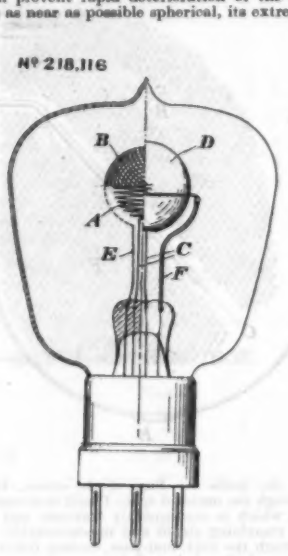
The object of this invention is to enable voltage impulses that are impressed on the grid of one valve to impress similar and greatly amplified potential charges on the grid of another valve with very little distortion in the wave form. One method of carrying out the invention is shown. A is an impedance coil connecting the anode B of a thermionic valve to the positive




pole of a high-tension battery C. D is a condenser connecting the anode to an intermediate point E in the length of the winding of an auto-transformer F. One end, namely, G, of this auto-transformer winding is connected to the grid or control electrode H of a second thermionic valve, whilst the other end K of the auto-transformer is connected through a separate battery L to the filament M of the second valve. The anode N of the second valve is shown connected through the loud speaker O to the positive pole of the battery C. The filament of the valves should be electrically connected by a conductor P.—*July 3rd*, 1924.

218,116. July 17th, 1923.—An Improved Thermionic Valve for Use more Particularly in Wireless Telegraphy and Telephony, William Richard Bullimore, of Aberdeen Works, Aberdeen-lane, Highbury-grove, London, N. 5.

The object of this invention is to provide an improved form of thermionic valve which shall possess the advantages of a "hard" valve in that high voltages can safely be employed and of a "soft" valve in that gas ionisation takes place under conditions which prevent rapid deterioration of the valve. The filament A is as near as possible spherical, its extremities being

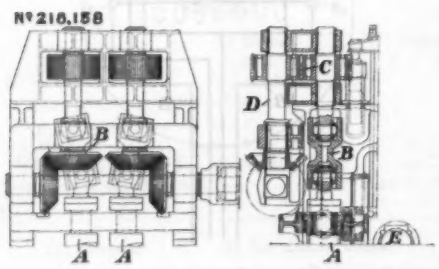



joined to the leading-in wires C, which are placed as close together as is consistent with adequate insulation. The filament A, grid B, and anode D are all of spherical form and are arranged as shown with the anode totally enclosing the other electrodes. The grid is supported by a stiff wire E and the anode by a similar support F, both of these wires constituting electrical conductors. In operation practically the whole electronic emission is intercepted by the grid and passes thence to the anode. In this way ionic emission does not interfere with the control, the construction being such that the grid is subjected to the maximum ionic influence.—*July 3rd*, 1924.

## MACHINE TOOLS AND SHOP APPLIANCES.

218,158. September 12th, 1923.—Universal Plate Rolling Mills, Duncan Stewart and Co., Limited, London-road Ironworks, Glasgow, and T. E. Holmes.

This invention is concerned with an improvement in the

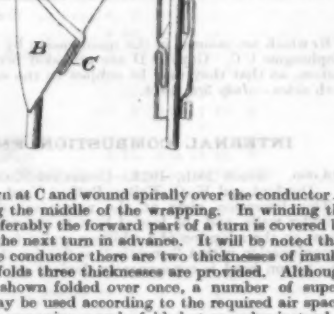



arrangements for driving the vertical rolls for forming the edges of plates rolled in mills which have to be adapted to various widths of plate. The vertical rolls A are driven through universally jointed shafts B and toothed gearing C from fixed vertical shafts D, which are driven by bevel wheels in the same direction as the main plate rolls E.—*July 3rd*, 1924.

## MISCELLANEOUS.

217,660. March 22nd, 1923.—Improvements relating to the Insulation of Electric Conductors, Siemens Bros. and Co., Caxton House, Tothill-street, London, S.W., and Arthur Ernest Foster, of "Fairlawn," Old Charlton, S.E. 7.

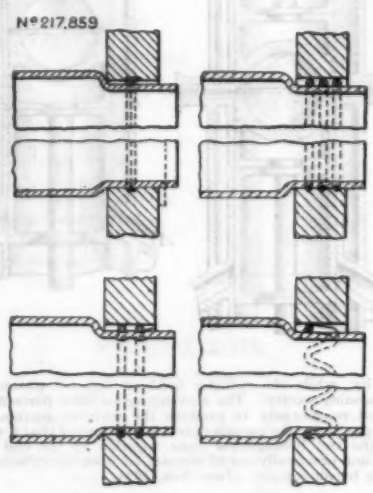
This invention has particular reference to conductors having an air space between the conductor and the insulating wrapping, as in the case of air space telephone cables. The object of the invention is to obtain greater uniformity in the capacity of the conductors comprising the cables, and means are provided for effectively centralising a conductor in the insulating wrapping. The conductor A is insulated by the wrapping B folded longi-




tudinally as shown at C and wound spirally over the conductor A. The fold is along the middle of the wrapping. In winding the wrapping on, preferably the forward part of a turn is covered by the rear part of the next turn in advance. It will be noted that at all parts of the conductor there are two thicknesses of insulation, and at the folds three thicknesses are provided. Although the wrapping is shown folded over once, a number of superimposed folds may be used according to the required air space. Furthermore, the wrapping may be folded at one edge instead of at the middle. The folding may be done by means of dies or formers, through which the wrapping passes before it is applied to the conductor. More than one fold may be made in the breadth of the wrapping.—*June 23rd*, 1924.

217,859. January 9th, 1924.—Fixing Tubes in Boiler Plates, *G. Brewer*, 33, *Chancery-lane, London.*

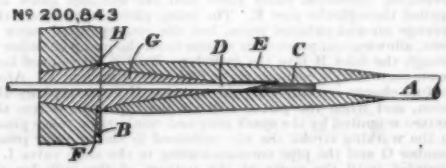
The inventor proposes to fix boiler tubes in the tube plates by means of wire rings. The rings are of harder metal than the tube




and plate, and when the tube is expanded the wire is crushed into both parts. The illustrations show several alternative styles of ring.—*June 26th*, 1924.

200,843. July 17th, 1923.—Improved Means for Connecting Submarine Cables to Junction Boxes, Felten and Guilleaume Carlswerk Actien-Gesellschaft of Koln, Mulheim, Germany.

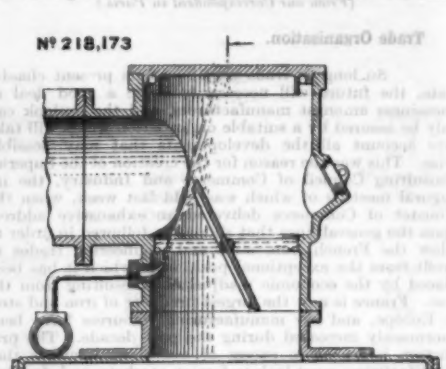
In the drawing A is the cable, B the wall of the junction box, and C the conductor which projects from the cable and which is connected with the conductor D leading into the junction box.




E is an insulator and protecting cover. The conductor D is inserted into the junction box by means of an india-rubber stopper F, which surrounds the conductor. The outer part G of this stopper consists of soft rubber and the inner part H of hard rubber. This part is made conical so that the water pressure forces it into the wall of the box.—*July 3rd*, 1924.

218,173. October 24th, 1923.—Washing Hot Gas Valves, L. Wilputte, 469, Fifth-avenue, New York.

In order to prevent the cut-off valves in the ascension pipes of gas retorts from becoming coated with pitch, which would otherwise prevent their being closed effectively, the inventor




proposes to "bathe" them with the mixture of tar and ammonia liquor condensed in the collecting main, which is ordinarily employed for flushing out the collecting main. The illustration represents one of several alternative arrangements for supplying the liquor.—*July 3rd*, 1924.

## Forthcoming Engagements.

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

SATURDAY, AUGUST 9TH.

North of England Institute of Mining and Mechanical Engineers.—Newcastle-upon-Tyne. Annual general meeting. 2 p.m.

## PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Brush Electrical Engineering Company, Limited, of Falcon Works, Loughborough, has transferred its Cardiff office to 22, Dumfries-place, Cardiff. The telegraphic address ("Falcon, Cardiff") and the telephone number (3464 Cardiff) remain unchanged.

The Bolton works of H. Bessemer and Co., Limited, which formerly belonged to the Bolton Iron and Steel Company and were taken over by Bessemers in 1903, have now been acquired, by arrangement with Messrs. Bessemer, by Thos. W. Ward, Limited, of Sheffield. It is not, so we are informed, likely that the works will be run again. In all probability they will be dismantled and sold in various directions.

We are asked to state that Mr. John Horne, A.M.I.E.E., who was for many years with the Metropolitan-Vickers Electrical Export Company, Limited, and the British Westinghouse Company Export Department, London, and latterly with the Westinghouse Electric International Company, has now joined Johnson and Phillips, Limited, as export sales engineer. His headquarters are at 12, Union-court, Old Broad-street, E.C. 2.

## CONTRACTS.

The Vickers-Spearing Boiler Company, Limited, of 20, Kingsway, W.C. 2, has secured a contract with the St. Pancras Borough Council for a complete boiler-house plant, including pulverised fuel plant equipment for the Council's electricity works.

The Underfeed Stoker Company, Limited, of Aldwych House, Aldwych, London, W.C. 2, has recently received orders for thirty-eight travelling grates, five ash conveyors, three air heaters, nine sets of suspended arches, and forty-six "Underfeed" stokers.

Siemens Brothers and Co., Limited, of Woolwich, have secured contracts for the manufacture and laying of about 3200 miles of submarine telegraph cable to connect the Cape Verde Islands with Rio de Janeiro, touching at the island of Fernando Noronha off the northern coast of Brazil. The first section is to be completed by the end of January, 1925, and the whole scheme should be in working order by the end of May, 1925.

The D.P. Battery Company, Limited, has just received orders from Newton Bros., Limited, of Derby, for two batteries for the telephone exchanges at Gloucester and Newport, the capacity in both cases being 4993 amp're-hours at the nine-hour rate. Provision will be made so that the capacity of these batteries may be increased to 9986 amp re-hours and 8812 amp re-hours respectively. In addition to the large batteries, two smaller ones, each consisting of 150 cells, are also required for these exchanges.

The Power-Gas Corporation, Limited, of Stockton-on-Tees, informs us that it has recently received orders: (*a*) from Synthetic Ammonia and Nitrates, Limited, of Billingham, for the supply of three waste heat boilers to work in conjunction with mechanical water gas generators, each rated at two million cubic feet of gas per day, which were installed by it and have been in operation now for some little time at the works of that company. The boilers are designed to utilise the heat of both the blow and make gases; (*b*) from the same company, for a complete coke gas producer plant to generate 3½ million cubic feet of producer gas per twenty-four hours, cooled and cleaned for process work; (*c*) for a coal gas retort generator plant with direct by-product recovery for the Yokohama gasworks, with an initial capacity of one million cubic feet per day and suitable for extension to three million; and (*d*) for a gas power plant for the Bwana M'Kubwa Copper Mining Company, Limited, to be erected in Northern Rhodesia in connection with mining equipment.